F (Hz)	C (µF)	Compensation step (m)
1700	33	100
2000	33	100
2300	22	100
2600	22	100

Important

Extreme half-step should be equal and have a length included between 35m to 85m.

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5. DESCRIPTION OF EQUIPMENT

5.1 Equipment at the wayside

Each unit (ACI, TU, MU) is contained in a box with a removable cover which can be locked by means of a padlock (diameter 10.5 mm maximum) providing protection against vandalism.

5.1.1 Air core inductor (ACI) Appendix 12

The ACI is common at all frequencies,

The ACI consists of a large section (35 mm²) litz wire winding, with a centre-tap, embedded in glass wool fabric.

It is installed in a light colour polyester box. The box features two side openings for the inductor output terminals and one opening located underneath for the centre-tap connection.

The ACI weighs 6.94 kg. Dimensional data are given in appendix 12.
Attachment is on a mounting stake.

5.1.2 Tuning unit (TU) Appendix 13

There is one tuning unit for each of the 4 frequencies used.

Each tuning unit comes in the form of a light colour laminate box, with a removable cover for access to the connecting terminal block. The tuning unit attaches to the mounting stake by means of two bolts at the rear of the box.

It consists of capacitors and inductor and the assembly is embedded in moulding compound.

The weight of the tuning unit varies from 4.94 kg to 5.54 kg depending on its tuning frequency. Dimensional data are given in appendix 13.

5.1.3 Pin Point Detector Unit (PPDU) Appendix 14

There is one PPDU for each of the 4 frequencies used.

The PPDU consists of a resonated pick up coil of triangular shape. This unit is fully sealed in fibre glass case with fixing lugs. Two protected output terminals are provided

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for the connection of cable.

The PPDU weighs 11.5kg. Dimensional data are given in appendix 14.

5.1.4 Matching Unit (MU) Appendix 15

The matching Unit, common to all frequencies, comes in the form of a light colour polyester box, fitted with a removable cover for access to the connecting strips.

It includes:
- a transformer used for setting the winding ratio,
- an inductor used when connecting a transmitter,
- a resistor used only when the MU is used as an Intermediate Data Collector.

The MU attaches to a mounting stake by means of two bolts at the rear of the box.

Dimensional data are given in appendix 15.

There are two different presentations for the MU:
- a Single Matching (only one MU in a box),
- a Double Matching Unit with two identical MU in a box.

5.1.5 Compensation capacitors Appendix 16

The capacitors (22 µF or 33 µF) have 2 multi-stranded copper connection cables of a 7.4 mm² section with light insulation.

Each end is provided with a rail mounted terminal.

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5.2 Equipment installed in a cubicle or equipment room Appendix 20

Equipment NS1 installed in cubicles or equipment rooms consists of a complete range of automatic connection equipment. This provides the highest level of inherent safety and ease of installation in confined space through the use of modular elements.

This equipment is classified into three categories:

- Fixed equipment including the chassis and associated equipment (fixed parts of connectors, "faston" terminals, wiring, locking system, etc.).
- Accessory equipment (fuse-holders, disconnecting strips, diode strips, etc.) connecting to the components making up the fixed equipment.
- Mobile modular equipment (transmitters, receivers and relays). Each assembly is fitted with 2 or 4 attaching lugs, one support plate locking cam and coding pins to prevent installation or replacement of a given equipment by a different type.

5.2.1 Support plate

The chassis functional part consists of panels or support plates whose main component is a U-section with 65-mm modular pitch perforations.

Each support plate modular pitch features:

- two large openings to accommodate PFC-12 or PFC-0 connectors, or PFO blanking connectors,
- two slots to accommodate the mobile equipment attaching lugs (transmitter, receiver, relay),
- one opening for the locking cam,
- eight notches for coding.

5.2.2 Connectors PFC-12, PFC-0 and PFO

The fixed part of a PFC-12 connector occupies one of the large openings in the support plate. It consists of an insulating material base equipped with 12 contact spring blades.

Each blade can accommodate, at the rear end, two "miniature faston" female clips. Up to 24 miniature "faston" clips can be installed on a PFC-12 connector.

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The connector blades are protected by a plastic cover.

The large support plate openings, not occupied by the PFC-12 connectors, are equipped with PFO blanking plates or PFC-0 connectors.

Installation of the PFO and PFC-0 blanking plates depends on how the equipment is fixed.

For equipment with 1 and 2 modules, the openings of the plate not occupied by PFC-12 connectors are blanked by PFC-0 connectors.

For equipment with 3 modules and over, the openings not occupied by PFC-12 connectors are blanked by PFO plates (see table below).

TYPE OF EQUIPMENT	NB OF PFC-12	NB OF PFC-0	NB OF PFO
Receiver	2	0	2
Transmitter	2	0	2
Power Supply	1	0	3

PFC-0 connectors are also used with letter-coded equipment.

5.2.3 **Transmitter unit** Appendix 17

The transmitter unit comes in the form of a 3-module metal box with a deep cover, whose rear face features the connecting sockets, locating devices and system for attachment to the U-section located in the cubicle.

There is one type of transmitter unit per operating frequency.

The transmitter weighs 2.8 kg. Dimensional data are given in appendix 17.

5.2.4 **Receiver unit** Appendix 18

The receiver unit comes in the form of a 2-module metal box, with a deep cover, whose rear face features the connecting sockets, locating devices and system for attachment to the U-section located in the cubicle.

There is one type of receiver unit per operating frequency.

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The receiver weighs 1.88 kg. Dimensional data are given in appendix 18.

5.2.5 Power supply unit Appendix 19

The power supply unit comes in the form of a 2-module metal box, with a deep cover, whose rear face features the connecting sockets, locating devices and system for attachment to the U-section located in the cubicle.

Dimensional data are given in Appendix 19. The power supply unit weighs is 4.3kg.

5.2.6 Track relay

relay type 24V DC 250 ohms
supply by customer

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5.3 Wiring Appendix 20

Connections between fixed items of equipment are provided by 1 mm² section single-wire flexible conductor, with a vinyl polychloride insulation under a polyamide sheath (CVZ series for example).

This cable is also used for connection to the collector bars and isolation components.

Connections between chassis are provided by 1 mm² section flexible pair cables, with a vinyl polychloride insulation and protection.

Connection to the PFC-12 connector blades is provided by miniature "faston" clips crimped onto the conductors.

Electrical connections between fixed equipment and mobile equipment connectors are provided by the pressure exerted by the contact blades of the connector fixed parts onto the end of the mobile equipment output blades. This pressure is provided by the downward motion following cam locking. The fixed part rear connections are provided by miniature "faston" type pre-insulated female clips.

The cable used to provide the link between the equipment rooms or the cubicles and the units to the track is an armoured cable with 1 mm² section paired conductors. The armour of these cables is connected to earth at both ends.

NOTE:

Each pair of wires, corresponding either to the output of a transmitter, or to the input of a UM 71 type receiver must be slightly twisted between the transmitter or the receiver and the cable outlet to the point and crossing.

IMPORTANT:

The following routing arrangements within one same cable are prohibited :

- **one transmission and one reception with the same frequencies,**
- **2 transmissions or 2 receptions with the same frequencies.**

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6. INSTALLATION OF THE EQUIPMENT

6.1 Equipment at the wayside

The way side equipment, TU, ACI, and MU, are installed on mounting stakes. (Also called mounting stakes).

See appendix 29

The mounting stakes component parts are soft steel and assembled by welding. The assembly must be galvanized for protection against humidity-related corrosion.

NOTE:
The mounting stakes may be different from that shown in appendix 28. However, in any case, the attaching hole should be drilled 20mm from the top of the pole, and the flat iron should be 6mm thick.

The equipment is stabilised by using a concrete base.

CAUTION:
As the ACI is an inductive equipment, any metallic material near the ACI will affect its characteristics.

6.1.1 Termination on electrical separation joint

Direction for the installation of a ESJ, see Appendix 21

6.1.1.1 ESJ Installation

Each electrical joint physically consists of :
- a track section,
- two tuning units (TU),
- two single matching units or one double matching unit, placed on the transmission side,
- one air core inductor (ACI),
- cables connecting the equipment to the track,
- connecting cable between the MU and the transmitter/receiver.

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6.1.1.2 Cables

TU,ACI - to Rails connection cable
- Section : 92 mm² (37/1.78)
- Nature : Light insulation multi-strand copper
- Lengths :
  . unit-to inner rail link : 3.00 m,
  . unit-to-outer rail link : 4.70 m
- Connections
  . rail side : aluminothermic welding or drilling
  . unit side : 13 mm crimped or soldered lug.

TU-to-MU cables
- Section : 4 mm²
- Nature : multi-strand copper (7/0.85)
- Iinsulation : PVC
- Length : 50cm max

MU - to - Transmitter or Receiver connnecting cables
- Section : 1.37 mm²
- Nature : PVC shielded par (7/0.5)
- Length : 150m max.

6.1.1.3 Special layout requirements

The low impedances involved in the tuning of an electrical separation joint dictate that all the component parts installation instructions should be strictly observed. The following points must be observed:

- ESJ length,

- layout and positioning of units (TU, ACI, MU),

- positioning and length of the track cables,

- the cables shall be contiguous throughout their common travel and positioned on the sleeper edge. The cables shall run through tubes which shall provide additional mechanical protection and stable positioning. Between the inner rail and the unit, the 2 PVC tubes shall be held contiguous by means of plastic clamps. Do not use metal clamps.

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- the track length making up the ESJ shall be free of:
  . mechanical joints,
  . connection points to the rail other than those of ESJ component parts: Spark Gaps for exemple.

6.1.2 Termination on insulated rail joints (IRJ)

Direction for the installation of a insulated joint configuration, see Appendix 22.

6.1.2.1 IRJ Installation

A termination on insulated rail joints, set up in transmission or reception, features :
- an assembly consisting of a TU and an ACI coupled in parallel,
- a matching unit MU,
- connecting cables between the MU and the TU,
- connecting cables between the MU and the transmitter or receiver
- two connecting cables between the ACI and the track or the impedance bond,
- two connecting cables between the ACI and the TU.

6.1.2.2 Cables

ACI - to - rails
- Section : 92 mm² (37/1.78)
- Nature : Light insulation multi-strand copper
- Lengths :
  . unit-to-inner rail link : 3.00 m,
  . unit-to-outer rail link : 4.70 m
- Connections
  . rail side : aluminothermic welding or drilling
  . unit side : 13 mm crimped or soldered lug.

ACI to impedance bond cables
- Section : 92mm² (37/1.78)
- Length : up to 5 m

TU - to - ACI cables
- Section : 35 mm²
- Nature : copper (19/1.53)
- Insulation : light
- Length : 0.18m ± 0

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TU - to - MU cables
- Section : 4 mm²
- Nature : multi-strand copper (7/0.85)
- insulation : PVC
- Length : 1.80m max

MU - to - Transmitter/Receiver connecting cables
- Section : 1.37 mm²
- Nature : PVC shielded par (7/0.5)
- Length : 150m max.

6.1.3 Intermediate transmission (IT)

Direction for installation of intermediate transmission configuration, see appendix 23

6.1.3.1 IT Installation

An intermediate transmission features:
- an assembly consisting of a ACI and an TU coupled in parallel,
- a matching unit (MU),
- two connecting cables between the ACI and the track,
- two connecting cables between the ACI and the TU,
- two connecting cables between the MU and the TU,
- connecting cables between the MU and the transmitter.

6.1.3.2 Cables

ACI - to - rails cables
- Section : 92 mm² (37/1.78)
- Nature : Light insulation multi-strand copper
- Lengths :
  . unit-to-inner rail link : 3.00 m,
  . unit-to-outer rail link : 4.70 m
- Connections
  . rail side : aluminothermic welding or drilling
  . unit side : 13 mm crimped or soldered lug.

TU - to - ACI cables
- Section : 35 mm²
- Nature : copper (19/1.53)
- Insulation : light
- Length : 0.18m ± 0

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ACI - to - MU cables
- Section : 4 mm²
- Nature : multi-strand copper (7/0.85)
- Insulation : PVC
- Length : 1.80m max

MU - to - Transmitter connnecting cables
- Section : 1.37 mm²
- Nature : PVC shielded par (7/0.50)
- Length : 150m max.

6.1.4 Intermediate Data Collector IP

Direction for the installation of an information point, see Appendix 24

6.1.4.1 IP Installation

The IP is installed in the track circuit between transmission and reception.

It features:
- a matching unit MU,
- the cables connecting the MU to the track.
- the cables connecting the MU to the Receiver

6.1.4.2 Cables

MU-to-track connecting cables
- Section : 7.4 mm²
- Nature : multi-strand copper
- Length :
  . MU-to-inner rail link : 3.00 m,
  . MU-to-outer rail link : 4.70 m
- Connection to the rail by pegging or welding.

MU - to - Receiver connnecting cables
- Section : 1.37 mm²
- Nature : PVC shielded par (7/0.50)
- Length : 500m max.

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6.1.5 Intermediate Data Collector PPD

Direction for the installation of a pin point detector, see Appendix 24

6.1.5.1 PPD Installation

The PPD is installed in the track circuit between transmission and reception.

It features:
- a pin point detector unit (PPDU),
- a Matching Unit (MU),
- the cables connecting the PPDU to the MU and the MU to the Receiver.

6.1.5.2 Cables

PPDU - to - MU cables
- Section : $4mm^2$
- Nature : multi-strand copper (7x0.85)
- Length : up to 6m

PPDU - to - Receiver connecting cables
- Section : $4\ mm^2$
- Nature : multi-strand copper (7x0.85)

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6.2 Equipment installed in racks or equipment rooms

Considering the heat-related constraints, precautions are to be observed as regards distribution of UM71 equipment on the NS1 chassis.

The items of equipment for which precautions are to be taken, are classified into three categories:

- Category A : Equipment releasing heat which requires 1 top-mounted ventilation module. The transmitter falls in this category.

- Category E : Heat-sensitive equipment which requires 1 spacer module when placed above or under a category A item of equipment. The spacer module is to be counted in addition to the ventilation module(s). The receiver falls in this category. However, a spacer module may always be occupied by an equipment other than category A, E or A+E equipment (relay for example).

- Category A+E : Equipment which falls in both categories described above. However, if an item of equipment of this category is installed under a category A equipment, only the ventilation module of the category A+E equipment shall be provided, without any spacer module.

Fuses located in the +24V link provide overcurrent protection for the transmitter and the receiver :
- transmitter: one 4-A slow-blow fuse,
- receiver: one 2-A slow-low fuse.

6.2.1 Installation Cubicle or equipment room equipment

Direction for installation of a room equipment, see Appendix 20.

6.2.1.1 NS1 support plates

The U-sections making up the support plates are installed on mechanical structure to make the chassis. Attachment can be by screws or welding.

The chassis are then installed either in a equipment room or in signal boxes.

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6.2.1.2 PFC-12 and PFC-0 connectors

Installation of the PFC-12 and PFC-0 connectors on the NS1 plates is as follows :
- insert the connector into the support plate opening, through the rear.
- fit the connector onto the U-section using the 2 screws.

6.2.1.3 PFO blanking plate

- Place the blanking plate in the large opening of the support plate, unoccupied by PFC-12 and PFC-0 connectors,

- Force-fit the PFO blanking plate into the large opening so that is snaps on the U-section.

6.2.1.4 Installation of the cable channels

Between two successive support plates, a cable channel is provided for the interconnecting wires. The cable channels are attached to the sides of the support plates. The cable channels are closed by covers that fit over the side walls.

On the wiring side, the side walls are perforated to allow for running the wires leading to the modular element PFC-12 connectors.

6.2.1.5 Modular equipment

A transmitter slot occupies 3 modules on a NS1 U-section equipped with:
- two PFC-12 connectors,
- two PFO blanking plates,
- a coding device to differentiate one of the transmitter types according to the frequency (Appendix 17).

A receiver slot occupies 2 modules on a NS1 U-section equipped with:
- two PFC-12 connectors,
- two PFC-0 blanking plates,
- a coding device to differentiate one of the four types of receivers according to the frequency (Appendix 18).

Installation of a transmitter, receiver, or power supply is as follows:

- Remove the protective cover from the PFC-12 and/or PFC-0 connector.

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- Insert the attaching lugs into the support plate perforated slots. The equipment contact blades are about two millimetres above those of the corresponding connector fixed section.

- Using the standard actuation key, actuate the cam located at the lower section of the mobile equipment so that it engages the support plate opening. Rotation of the cam causes the equipment to lower and lock against the support plate in a stabilized position. The 5 mm downward motion of the equipment ensures good electrical contact.

- Locking is effective when one of the points of the equilateral triangle defined by the end of the cam control rod is in the upper position. The cam travel limits are each materialized by a stop.

6.2.1.6 Coding

A mechanical coding device, specific to each type of modular equipment prevents any incorrect equipment positioning on the NS1 support plate. This coding consists of a pin network on the equipment side and, on equipment support side, of a hole matrix coded by blanking plugs. Each pin has the same number as the corresponding aperture in the support plate. The coding holes not receiving the equipment pins are blanked by coding plugs.

These plugs are plastic and force-locked in the unused holes of the support plate.

Coding of the support plates and corresponding mobile equipment is given in the table below:

EQUIPMENT TYPE	FREQUENCY (HZ)	CODE
TRANSMITTERS N.Co EM-MOD-V1F1 N.Co EM-MOD-V1F2 N.Co EM-MOD-V2F2 N.Co EM-MOD-V2F2	 1700 2300 2000 2600	 13-7-23 13-7-25 13-7-26 13-7-34
POWER SUPPLY UNIT N.Co BA-240.120/24 R		358-25
RECEIVERS N.Co RE-MOD-V1F1 N.Co RE-MOD-V1F2 N.Co RE-MOD-V2F1 N.Co RE-MOD-V2F2	 1700 2300 2000 2600	 24-8-26 24-8-35 24-8-34 24-8-36

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6.2.1.7 Connections

The connections between transmitter or receiver and the track cable outlet are dual-insulation, 1mm² section, twisted multi-strand wires. Any incoming or outgoing link, from the cubicle or the equipment room is through a pull-out coupling unit.

Wiring is by dual insulation 1 mm² multi-strand wire. Connections are provided by "faston" lugs on the equipment side and by screws connections on the terminal strip and power supply side.

Any link between the contact blades concerning one equipment is provided similarly and must therefore run through the cable channels.

Each side hole of the cable channel geometrically corresponds to a conductor connected to one of the lugs fitted on each PFC-12 connector blades.

The jumpers to be set up on each receiver must run through the cable channel holes (setting up the jumpers directly on the receiver PFC-12 connectors should be avoided).

This arrangement allows the conductors arranged in superimposed horizontal layers to be fanned out. Moreover, when the connection clip is crimped on the wire, the clip can not be released from the wire feed-through. Therefore, even in the event of an accidental disconnection, it is easy to find its position.
Connection of the conductors is by fitting the clips either on the fixed equipment PFC-12 connector lugs, or on those of the collector bars.

Clip fitting shall be performed carefully, using a special miniature "faston" clip fitting tool.

6.2.1.8 Marking

Both faces of each chassis carries labels stating:
- the identification of the row in which the chassis is located,
- its sequence number in the row.

These indications are entered on the equipment and wiring sides:
- on the upper and lower transverse bars of the chassis as regards the row,
- on the chassis side-posts as regards the sequence number in the row.

Connection of "faston" lugs on the PFC-12 connectors is indicated by the labels affixed to the plastic bridge-pieces. These parts snap on the rear of the support plates.

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To install a label on one or bridge-piece or more, proceed as follows:

- place the label on the bridges, such that the holes in the labels and the support coincide.
- insert a fastener in each hole,
- inside the bridge-piece, bend the fastener tabs towards the outside,
- snap the bridge-piece assembly between two connectors of a module.

6.2.1.9 Condition of storage

The equipment is carried to the installation site in its original packaging, and stores in a dry, well ventiled area.

Do not store equipment close to equipment releasing corrosive vapors such as batteries.

Storage temperatures : - 30° C to + 70° C.

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7. TRACTION CURRENT RETURN CIRCUITS (DC-ELECTRIFICATION 1500 V)

The UM71 Track circuit is not designed to operate with traction current return through a single rail stretch. Consequently, the return circuits must be bi-rail type.

Current traction continuity at the insulated rail joints configuration and return current traction to substation can be done by the middle point of an impedance bond.

To reduce rail-ground voltages, the tracks can be interconnected by simple transverse links (STL).

A simple transverse link (STL) is an equipotential link between two tracks, without earthing (figure 11). It allows a reduction in the intensity of the traction return current in each rail.

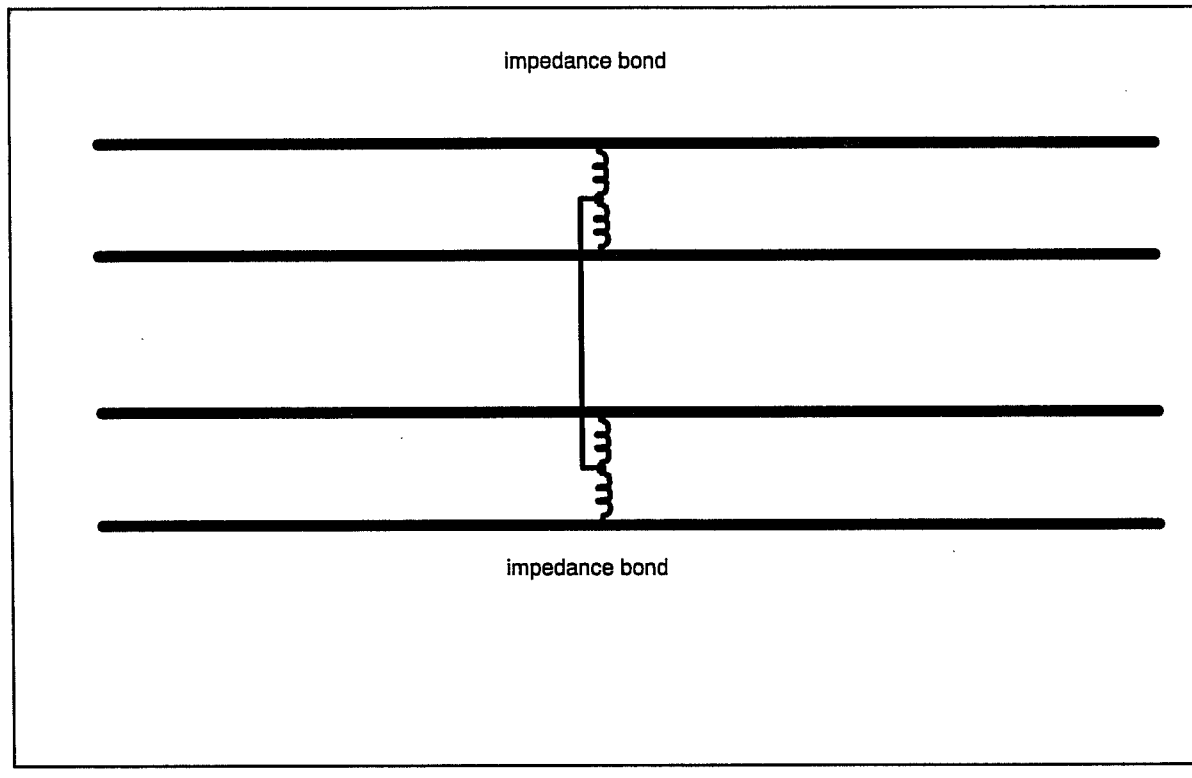

Figure 11 - Simple transverse link principle

The distance between two STL may not be less 1000m (see appendix 25).

Due to the fact that the return current is very high, it is not possible to use the middle point of the air core inductor to realize these STL. It is necessary to establish theses

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links through the centre taps of additional Impedance Bonds, installed in the UM71 Track Circuits.

These IB have to be an impedance higher than 17Ω at the frequency of the track circuit: generally they are tuned.

NOTES

1) When there are more than two tracks, a transverse link between two track circuits with the same frequency is prohibited (See figure 12).

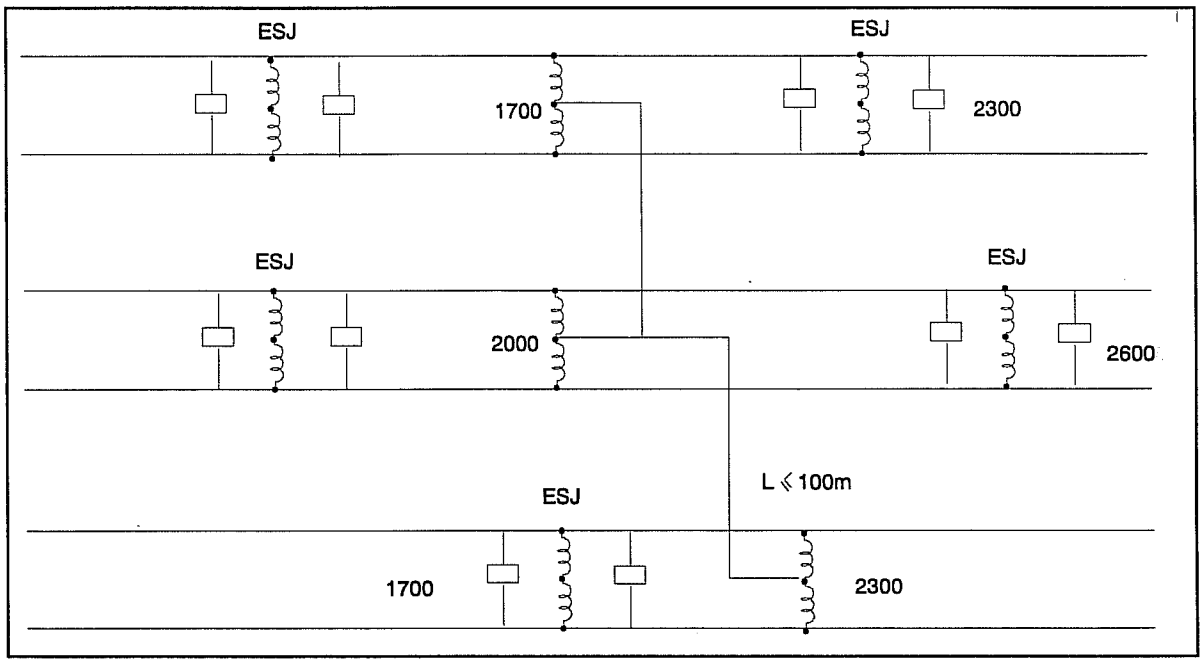

Figure 12

2) The IB cannot be installed at less than:
   - 20m to a track capacitor,
   - 100m to a air core inductor (ACI), except on insulated rail joints.

3) In a track circuit, it is not possible to have more than two external links.

   Are considered as external links:
   - links for return traction current,
   - transverse links,
   - links for protection.

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An Impedance Bond installed on isolated joints for the continuity of the traction return current on the same track, is not considered as an external link.

SPARK GAPS

Spark gaps connections should not be made within the ESJ and should be alternated on each rail midway through the track circuit.

NOTE

Under no circumstances should metal structures be linked directly to a rail.

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8. PROTECTION OF EQUIPMENT AGAINST ATMOSPHERIC VOLTAGE SURGES

8.1 General (Appendix 26)

In an equipment room as well as in a signal box, protection against atmospheric voltage surges shall be installed on each pair of conductors providing a link to the outside in order to limit the harmful effects of lightning on electronic equipment.

This protection is twofold and limits:

- the voltage (common mode) which may occur between the two conductors and earth,
- spikes which may occur between the 2 conductors (differential mode).

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8.2 Common mode protection

The common mode protection, connected between each conductor and earth, must be able to carry a large quantity of energy to earth.

This protection is provided by a lightning arrester (fig.1).

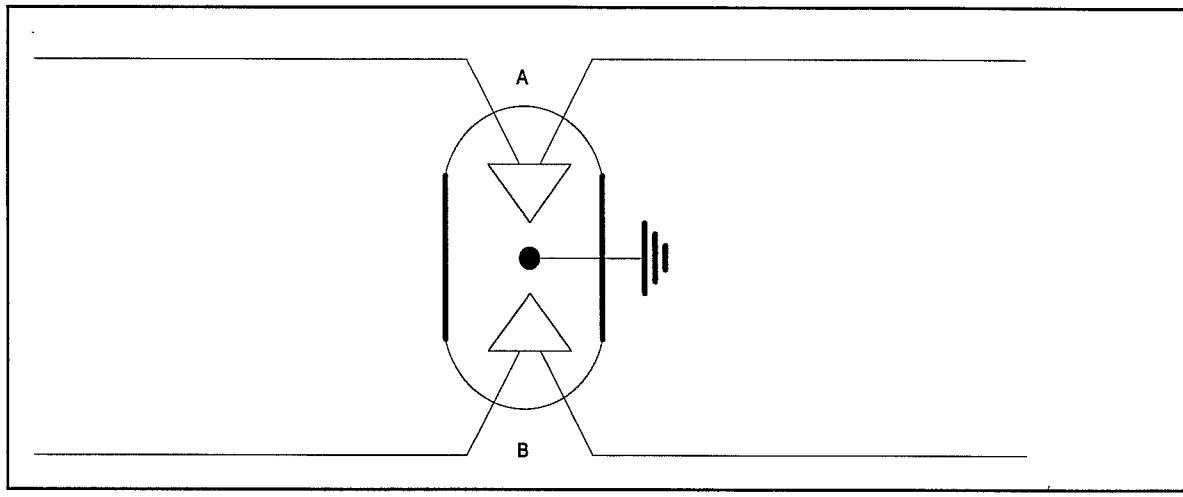

Figure 1 - Lightning arrestor

In normal operation, it must have infinite impedance between each of its terminals.

In the case of high conductor-ground voltage (several hundred volts), the lightning arrester is triggered. It then has very low impedance and the voltage is discharged.

When the stray impulse disappears, the lightning arrester ceases to conduct and its impedance returns to infinity.

REMARKS

(1) In the event of a failure, the lightning arrester must not be able to provide a short-circuit between one of the conductors (A or B) and earth, creating an undetected potential situation, contrary to the basic safety of the installation. Gas lightning arresters must be used.

(2) The use of an ELTEL type lightning arrester is recommended.

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It is also important to take care with the wiring of these lightning arresters (fig. 2).

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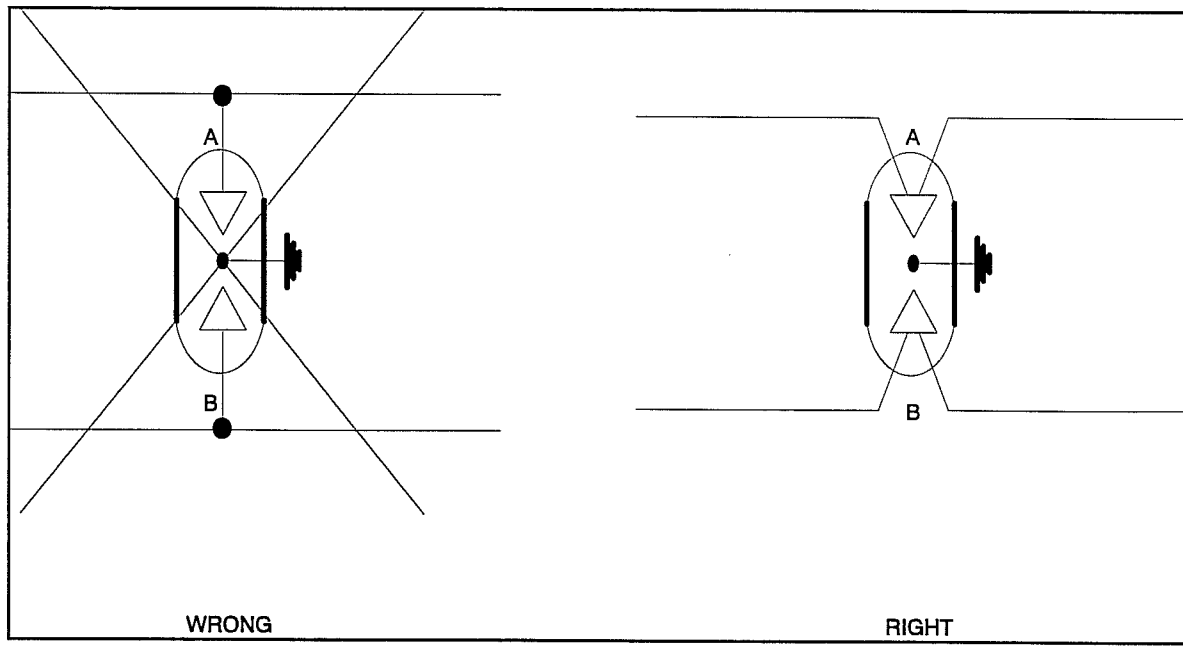

Figure 2 - Wiring of ELTEL lightning arresters

These lightning arresters should be wired close to the equipotential bar so that the link to earth is as short as possible.

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8.3 Differential mode protection

Differential mode protection has no link to earth. It therefore in no way compromises safety.

This protection can be provided by any component using any technology able to discharge high energy for a short period of time.

The component used is generally a Transzorb or a varistor (Transient Voltage Suppressors), easily mounted in a component connection block.

The following types are recommended:
- model 1.5KE200 from GACI,
- model V130LA20A from HARRIS,

or equivalent.

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8.4 Installation of protection

8.4.1 UM 71 transmitter or receiver alone

The link between transmitter and MU is protected by (see figure 3):

(1) a Transzorb 1.5KE200 or V130LA20A or equivalent.

(2) an ELTEL 120A 500 V lightning arrester

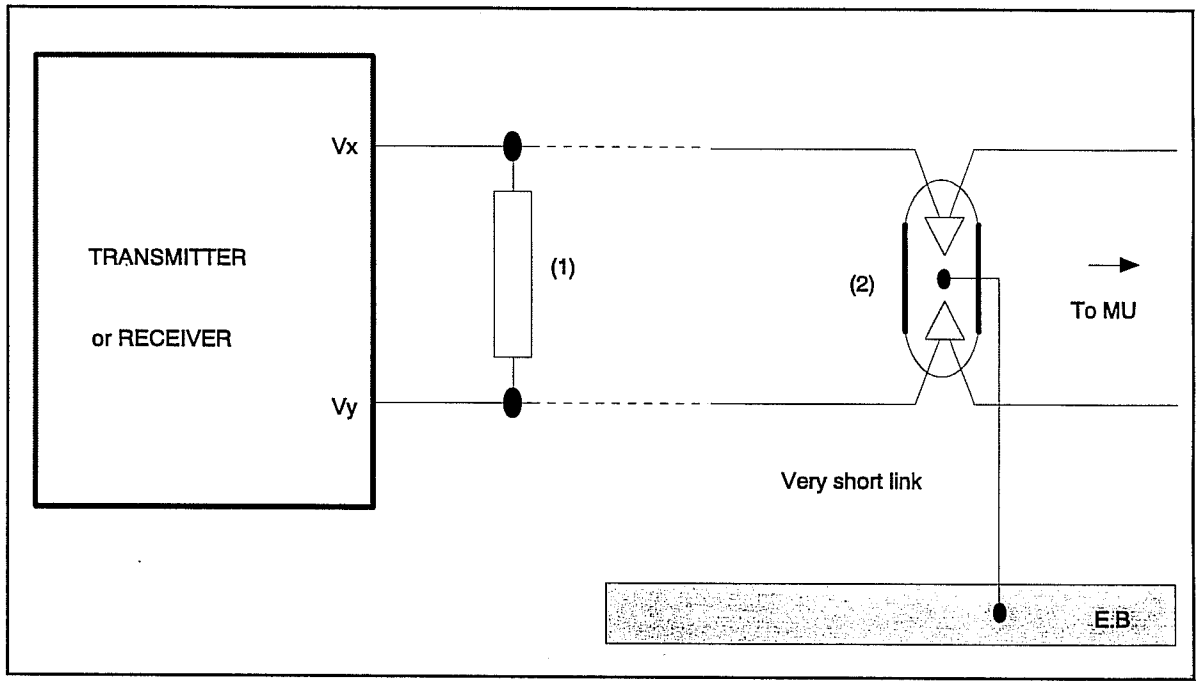

Figure 3 - Protection of a transmitter or receiver

8.4.2 Installation of a transmitter or receiver

IMPORTANT REMARK

A transmitter and a receiver with same frequency cannot use the circuits of the same ELTEL lightning arrester.

The use of an ELTEL type lightning arrester offers simultaneously protection of the transmitter and the receiver in the same cubicle (see figure 4).

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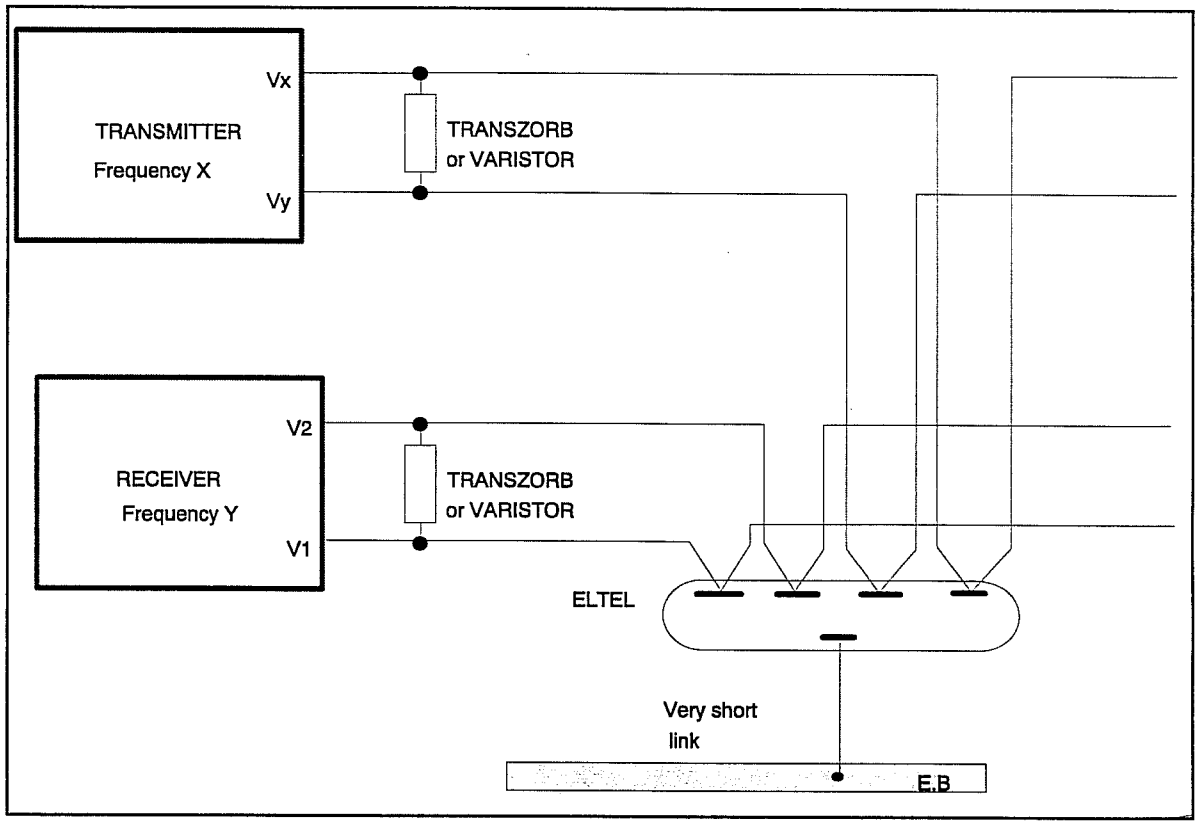

Figure 4 - Protection of a transmitter or a receiver

8.4.3 Power supply protection

In the case of AC power supply line, a lightning protection is advised (type SOULE 8137 for example): fig. 5.

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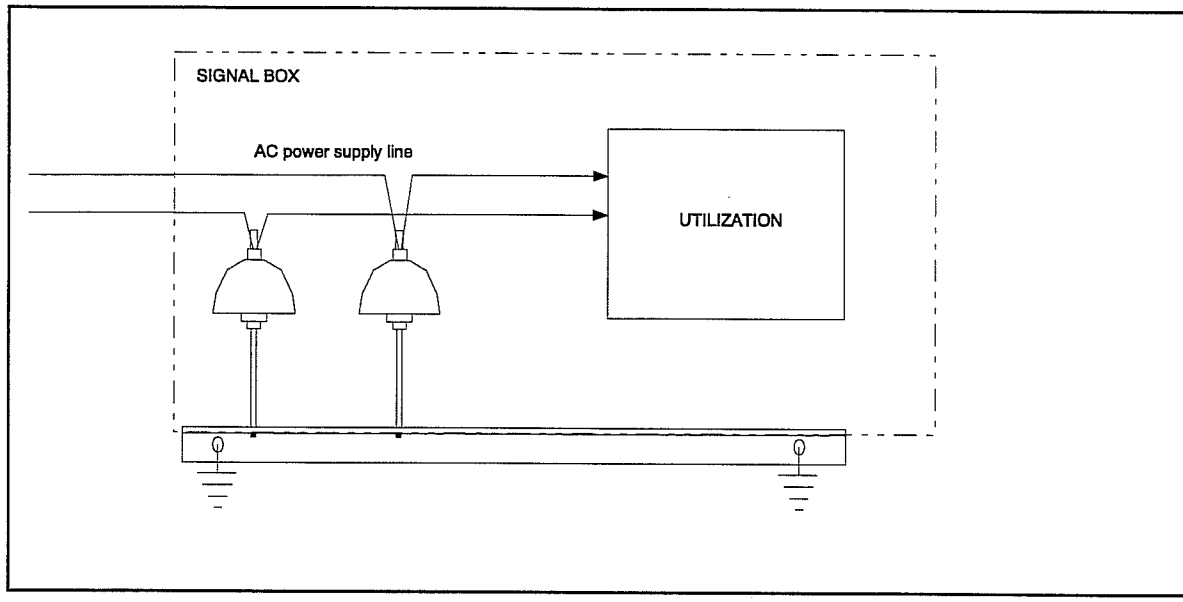

Figure 5 - Power supply protection

The lighting arrester must be inserted in series with the power supply circuit, not in parallel with it (see figure 6).

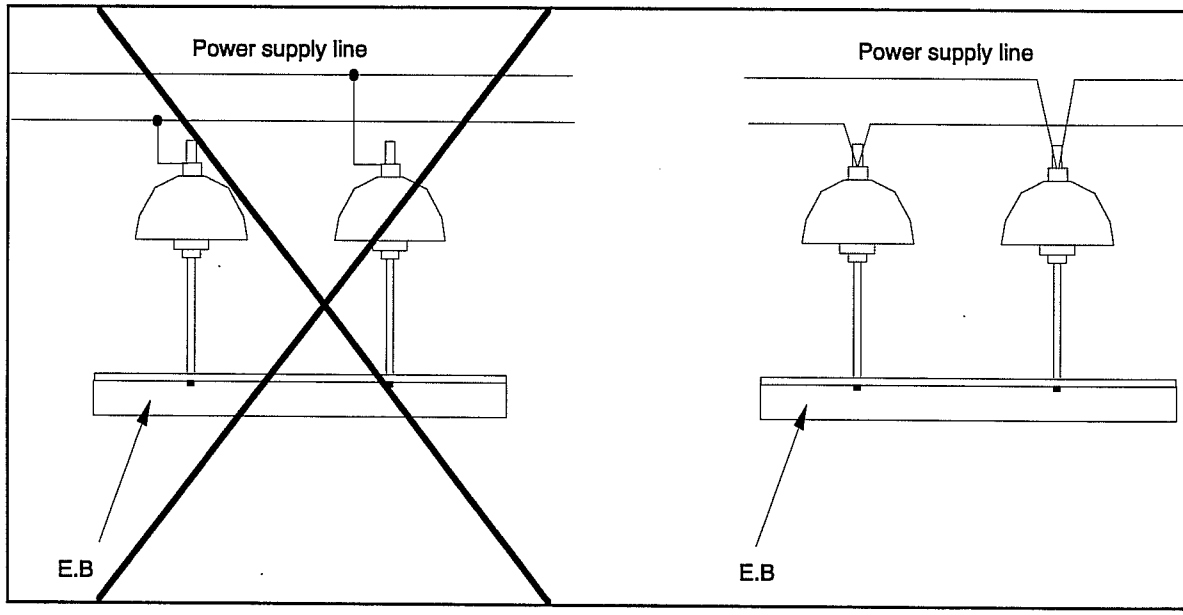

Figure 6 - SOULE lightning arrester wiring

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9. INSTALLATION ACCESSORIES

9.1 Cubicle or equipment room equipment

9.1.1 Equipment

- mechanical crimping tool P/N 476 268,
- wire strippers,
- miniature "faston" clip fitting tool,
- "Faston lug" plug in pliers
- actuation key

9.1.2 Miniature "faston" clip crimping procedure

Miniature "faston" clips are crimped on the conductors using a special hand tool. This tool features a safety ratchet to prevent the jaws from opening and the clip from being released as long as crimping is not complete.

The crimping procedure is as follows (see appendix 20):

- run the wire through the hole provided for this purpose in the cable channel,
- strip the electrical wire over 5 mm ± 0.5 using wire strippers so as not to hurt the conductor strands,
- crimp the "faston" lug end fitting using the crimping tool.

For correct crimping, ensure that the outer crimping flange is on the conductor side, not on the clip side (see appendix 20).

This appendix shows a correct crimping sample.

9.1.3 Faston clip insertion / removal procedures

The faston clip are installed and removed using the special pliers (see appendix 20). When inserting a clip, the lug should offer firm resistance as its slides on and a positive lock should be felt when the clip lug seats in the spring hole.

Clips should be replaced with a new clip if thy are removed twice from the contact spring.

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10. SETTING AND COMMISSIONING OF UM 71 TRACK CIRCUITS

10.1 Setting

10.1.1 Setting generation

The settings of the UM 71 track circuits are generated by simulation according to:

- the configuration of a track circuit:
  . end of section transmission,
  . intermediate transmission.

- the frequency of a track circuit

- the length of the area,

- the termination configuration :
  . electrical separation joint,
  . insulated rail joints.

- the theoretical limit shunt : 0.10 Ω

- the length and nature of the transmission and reception cables,

- the primary track parameters (R, L, G, C) which take account of :
  . the type of track laying,
  . the type and chemical composition of the rail,
  . the track transverse impedance.

10.1.2 Set Up Table

For each track circuit, four set up tables have been defined. One per frequency.

The set up table shows for each track circuit length the set up value and control.

The track circuits length are defined as follow:
- 25 m step for non compensated T/C,
- 100 m step for compensated T/C.

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NOTE:

The set up track circuit lengths are measured from TU to TU. Note that the T/C are measured from ACI to ACI. Therefore, it is necessary to substract:

- **a ESJ length in the end of section transmission case,**
- **a half ESJ per branch in intermediate transmission case.**

10.1.3 Setting factors

According to the parameters described above, the following factors are determined for each track circuit:

- A transmission level, "KEM", implemented by external links on the transmitter.
- "KRV" receiver parameter is defined for track circuits used at extreme environmental conditions.

Those values are mainly defined in accordance with track insulation. Ballast value can vary from 1.5 ohm.Km and infinity. The KRV adjustment is implemented by external links on the receiver.

KEM and KRV setting implementation tables are given in appendix 27.

10.1.4 Setting brackets

For each track circuit length, a set up table define the range in which can vary the track circuit voltages.

"Min" and "Max" values delimit the extreme operating conditions of the track circuit, i.e.:

- Minimum values:
  . the minimum voltage which can be generated by the transmitter,
  . the worst case track transmission (min. ballast 1.5 ohm.Km).

- Maximum values:
  . the maximum voltage which can be generated by the transmitter,
  . the best case track transmission (infinite ballast).

Additional margins are applied to take account of the tolerances:

- on TU, ACI, MU, etc. impedances,
- on the primary parameters of the transmission/reception cables and the track.

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IMPORTANT

UNDER NO CIRCUMSTANCES SHOULD THE SETTING OF A TRACK CIRCUIT BE CHANGED. IN THE EVENT OF AN OPERATING FAULT OR MEASURED VALUES OUTACIDE THE SETTING BRACKETS, APPLY THE CORRECTIVE PROCEDURES DESCRIBED IN THE MAINTENANCE MANUAL.

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10.2 Data sheets

10.2.1 General

When a track circuit enters service, the following data should be entered on a data sheet in duplicate:

- the characteristics of the track circuit,
- the serial numbers of the installed equipment,
- the settings and inspection values,
- the current climatic conditions,
- the measurements made various points of the track circuit.

One copy of the data sheet may be maintained on site for preventive and corrective maintenance purposes. The other copy may be filed.

To facilitate equipment follow-up, it is recommended not to change equipment assignment. Each equipment making up the track circuit must be associated to the track circuit using its serial number.

Equipment replacement for repair or overhaul shall be made using an equipment taken from a reserve batch specially created for this purpose.

The equipment back from repair or overhaul shall be returned to service on its original circuit.

10.2.2 Description of the data sheet

The UM 71 TC system data sheet breaks down into five parts (appendix 28):

Part one
This front page concerns:

- the geographic position of the track circuit,
- the overall characteristics of the track circuit and special features.

Part two
This page concerns the equipment and provides the serial number of the equipment assigned to the track circuit.

Part three
This page contains the settings made as well as the connections to be established.

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Part four
This page contains the track circuit setting brackets:
- minimum and maximum service voltages determined by simulation under extreme operating conditions.

Part five
This page comes in the form of a table to be filled in after each preventive or corrective maintenance intervention, after replacement of a track circuit component.

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10.3 Adjustment and commissioning

The use of a selective voltmeter is required to make accurate measurements on the track circuits.

10.3.1 Track circuit UM71

Search for the set up table which meet your configuration and frequency. In the set up table search for the line which correspond to the track circuit lengh you want to adjust (arrounded to the upper value).

The UM 71 track circuit measurement and setting points are specified in appendices 21, 22 and 23.

1) Transmitter end

- Check the bonding and connections to the rails and the wiring and connections in the location are complete.
- Set up transmitter strapping (always M1-M3).
- for compensated T/C, apply this adjustment in high power, strap M2 to M4 and M2 to M5.
- Apply the KEM ratio indicated on the set up line with the KEM table shown in appendix 27.
- Power up transmitter and check voltage on terminals A+ and A- is 24 Volts (22.5V to 28.8V).
- Check and record the details, voltages and currents required on the track circuit data sheet:
  Val : power supply 24V DC
  Vtx : output voltage of the transmitter
  Itx : output current of the transmitter
  VT : the track tansmission voltage

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NOTE:
Generally in non compensed track circuit the transmitter is used in Low Power. With poor ballast, if we want to have a minimum voltage (300mv for example) at the reception, the transmitter have to be used in High Power.

It is important that on the oldest Transmitter (before DA series) the straps M2.M4 and M2. M5 must be good and very short because inside resistors are very low.

Since DA Series Transmitter, inside resistors are higher, so the length and the resistance contact of the straps are not so critical.

2) Receiver end

- Check the bonding and connections to the rails and the wiring and connections in the location are complete.

- Set up receiver strapping C - C2 (delay 2s).

- Power up receiver and check voltage on terminals A+ and A- is 24 Volts (22.5V to 28.8V).

- Receiver adjustment KRV ratio

  There are two adjustment possibilities:

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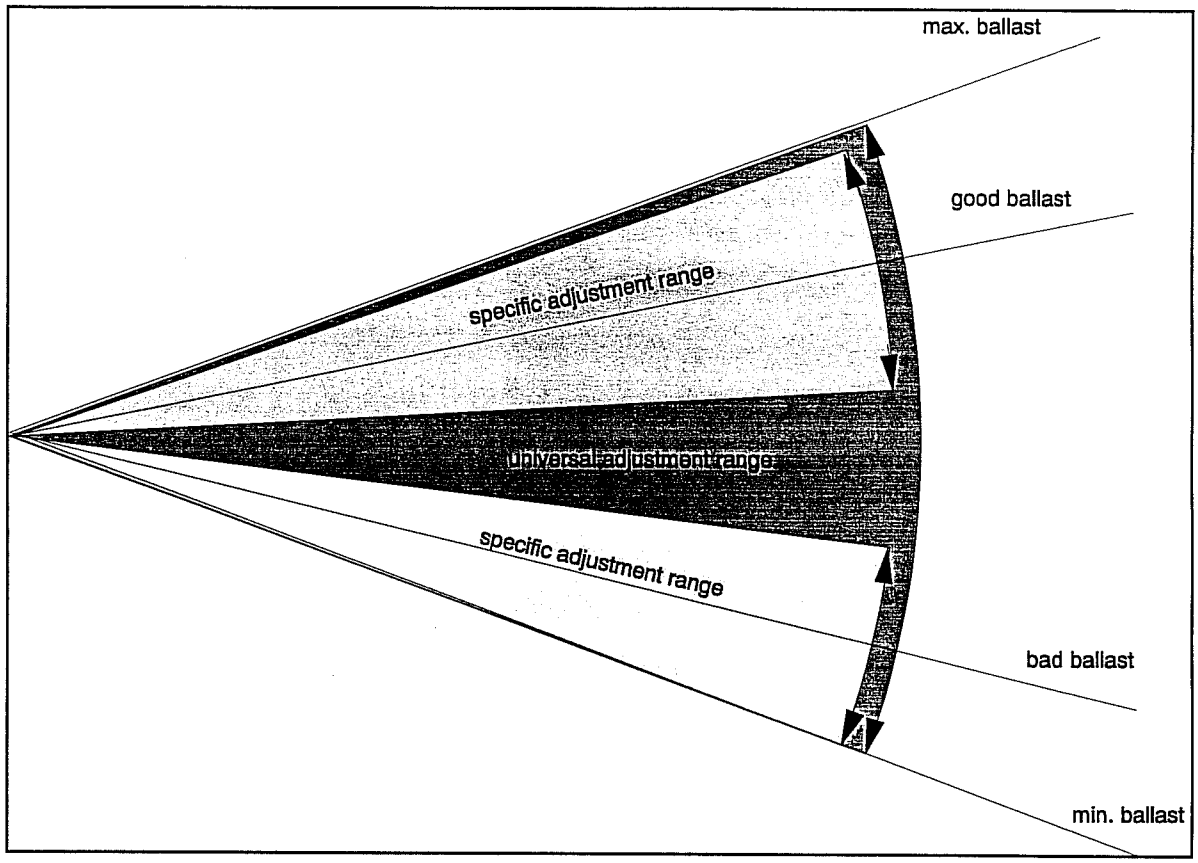

Figure 1 - adjustment ranges

1) Universal adjustment

This adjustment take into account any resistance ballast variation between 1.5 ohm. Km and infinity.

This adjustment provide a shunt efficiency of 0.1 ohm minimum in the worse condition to drop the T/C.

The adjustment voltage VR1R2 of the receiver can vary between the minimum and the maximum values indicated in the set up table.

2) Specific adjustment

Actually, the resistance ballast value vary in accordance to the climatics conditions: dry or humid. This average value is defined in accordance with the ballast condition. The specific adjustment range is lower than the universal adjustment range.

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Advantage:
It presents a lower dynamic. It can improve the shunt efficiency with a limit shunt value highest.

Disadvantage:
When the original adjustments have been done by dry weather, it might be necessary when it's wet to refine the KRV value to obtain at R1R2 receiver a voltage highest than 240mV.

In event of track improvement (i.e. ballast renewal) this set up should be re-adjusted.

A KRV ratio shall be define for each track circuit. This ratio is dependant of the tranversal insulation track (i.e. ballast value). The KRV ratio found shall fit in "KRVmin" and "KRVmax" range given by the set up table.

The receiver will "drop away" if the track voltage recieved at R1 and R2 connections is approximately 160mV and will "pick up" at 200mV with an ambiant temperature of 25°C.

The KRV ratio is defined to obtain at R1 R2 a avarage voltage value of 350mV.

You should proced as follow:

$$KRV = \frac{350mV \times 58}{VV1V2}$$

The KRV ratio is arrounded at the upper integer value.
VV1V2 is the measured voltage value at the receiver input.
In event of track improvement (i.e. ballast renewal), this set up should re-adjust.

This voltage could vary following the climatics conditions:
- by humid weather 240mV minimum,
- by dry weather 450mV maximum.

- Check and record the details and voltages required on the track circuit data sheet:
  VR : track reception voltage
  Val : power supply DC
  VVIV2 : receiver input voltage
  VR1R2 : receiver voltage level.

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NOTE:

The document "Adjustment Tables" gives KRV for an universal adjustment.

3) Checking the settings

- Check the track relay energization.
- Perform the measurements specified on the TC data sheet (part five).
- Check that the measured values fit within the specified brackets. Should any measurement be found out of tolerance, refer to the corrective maintenance manual.
- Perform a test of the 0,1Ω shunt, in transmission and in reception. Check for actual track relay drop-out for each operation (the shunt is located in the TC, 1 meter from the "pole" TU).
- Update the track circuit data sheets by entering the measurement results, specifying the current climatic conditions and date.

10.3.2 Intermediate data collector

1) Pin Point Detector

The PPD circuit measurement and setting points are specified in appendix 24.

- Check the PPDU emplacement compared to the rail
- Check the wiring
- Check the Boosting unit emplacement
- Set up receiver strapping C - C2 (delay 2s).
- Power up receiver and check voltage on terminals A+ and A- is 24 Volts (22.5V to 28.8V).
- Adjust R resistor or ratio on the MU to obtain at R1 and R2 of the receiver a voltage about 330mV (minimum 270mV).
- Check and record the details and voltages required on the track circuit data sheet VR1R2 : receiver voltage level

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Checking the settings

- Check the track relay energization.

- Perform a test of the 0,1Ω shunt, in transmission and in PPD reception. Check for actual track PPD relay drop-out for each operation (the shunt is located in the TC, 1 meter from the "pole" TU and the PPDU).

2) Information point

The IP requires a special adjustment which is in accordance of its emplacement in main the track circuit. Subject non treated in this document.

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APPENDIX 1

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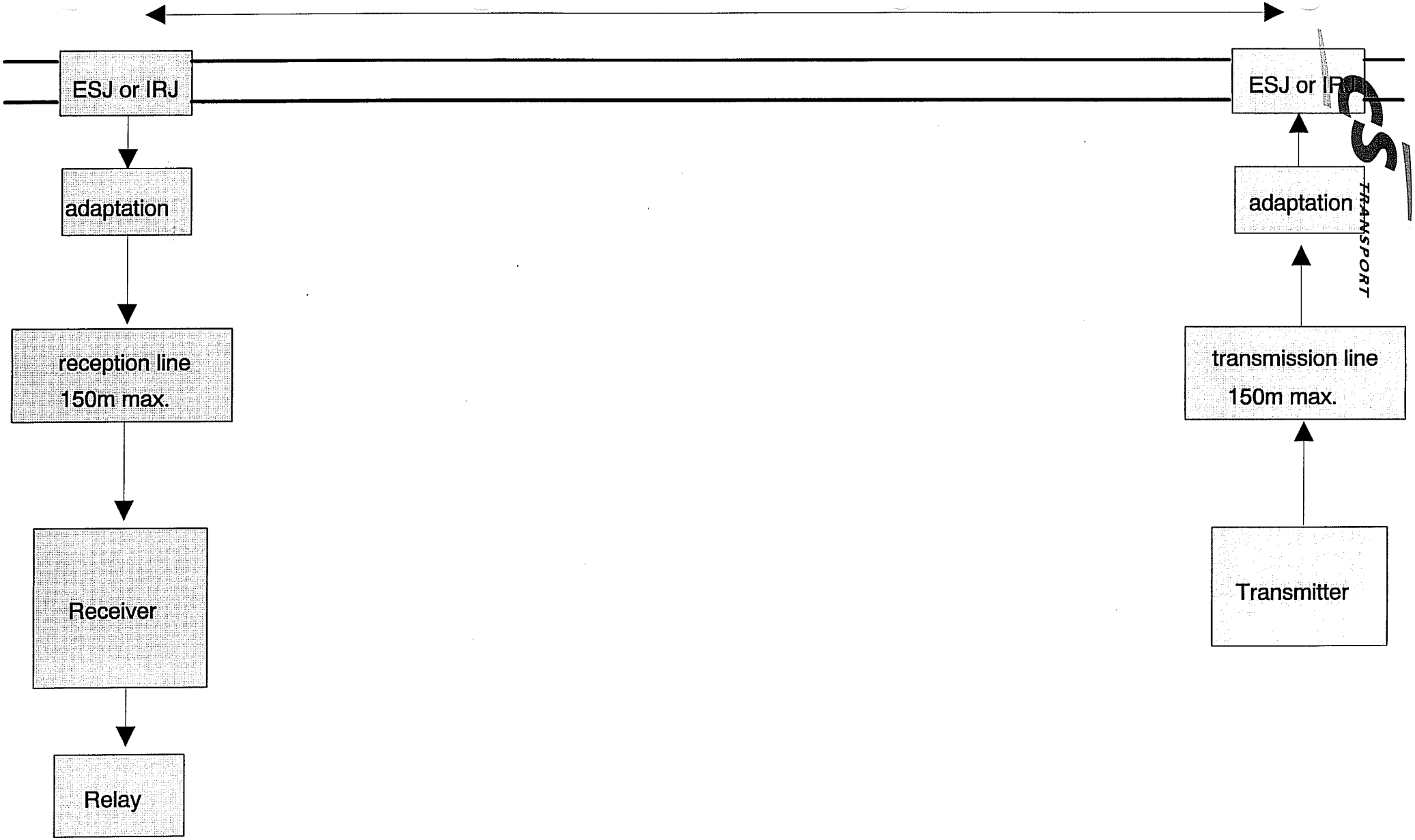
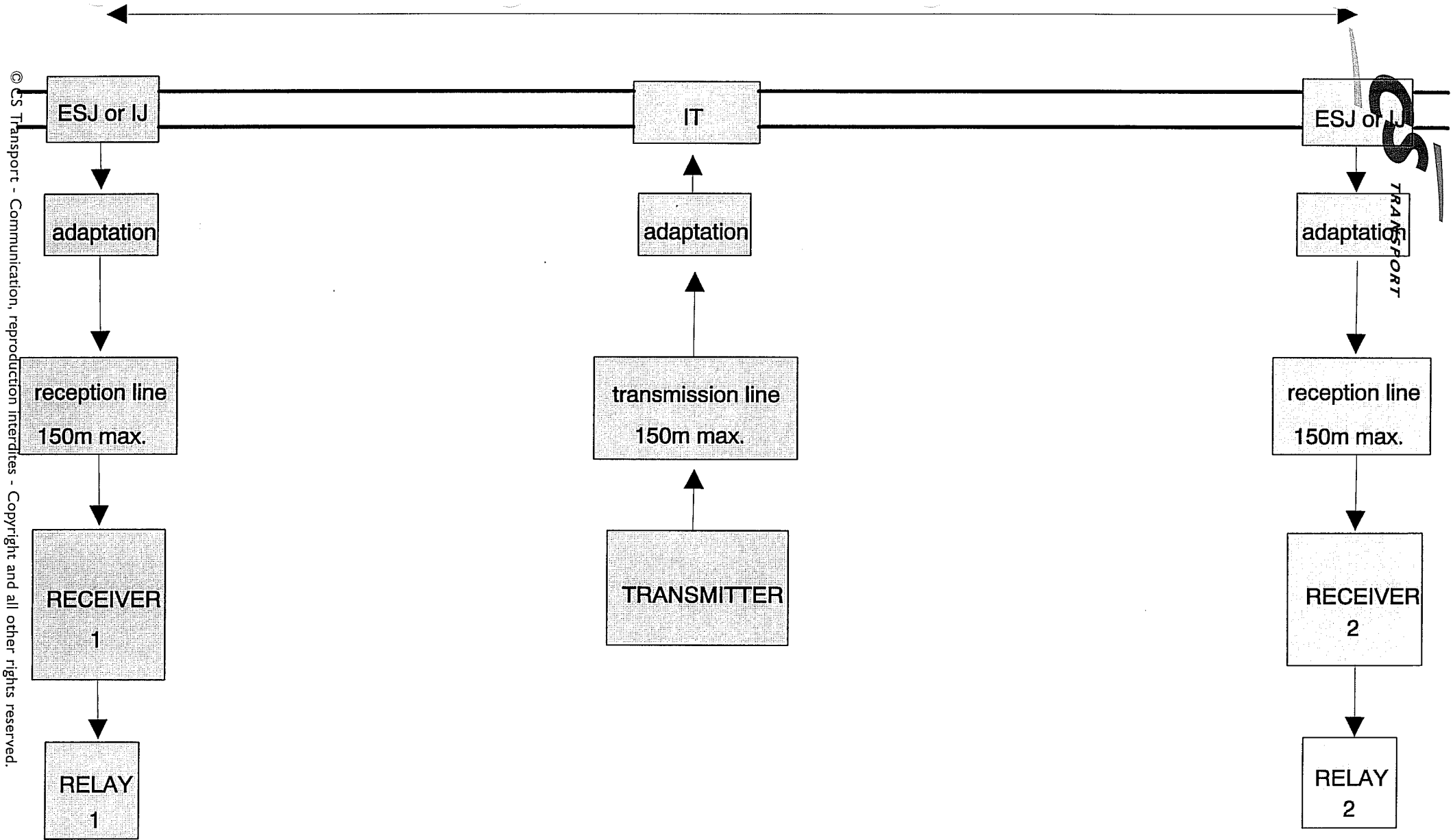


TRACK CIRCUIT WITH
END OF SECTION TRANSMISSION

A001



TRACK CIRCUIT WITH

INTERMEDIATE TRANSMISSION

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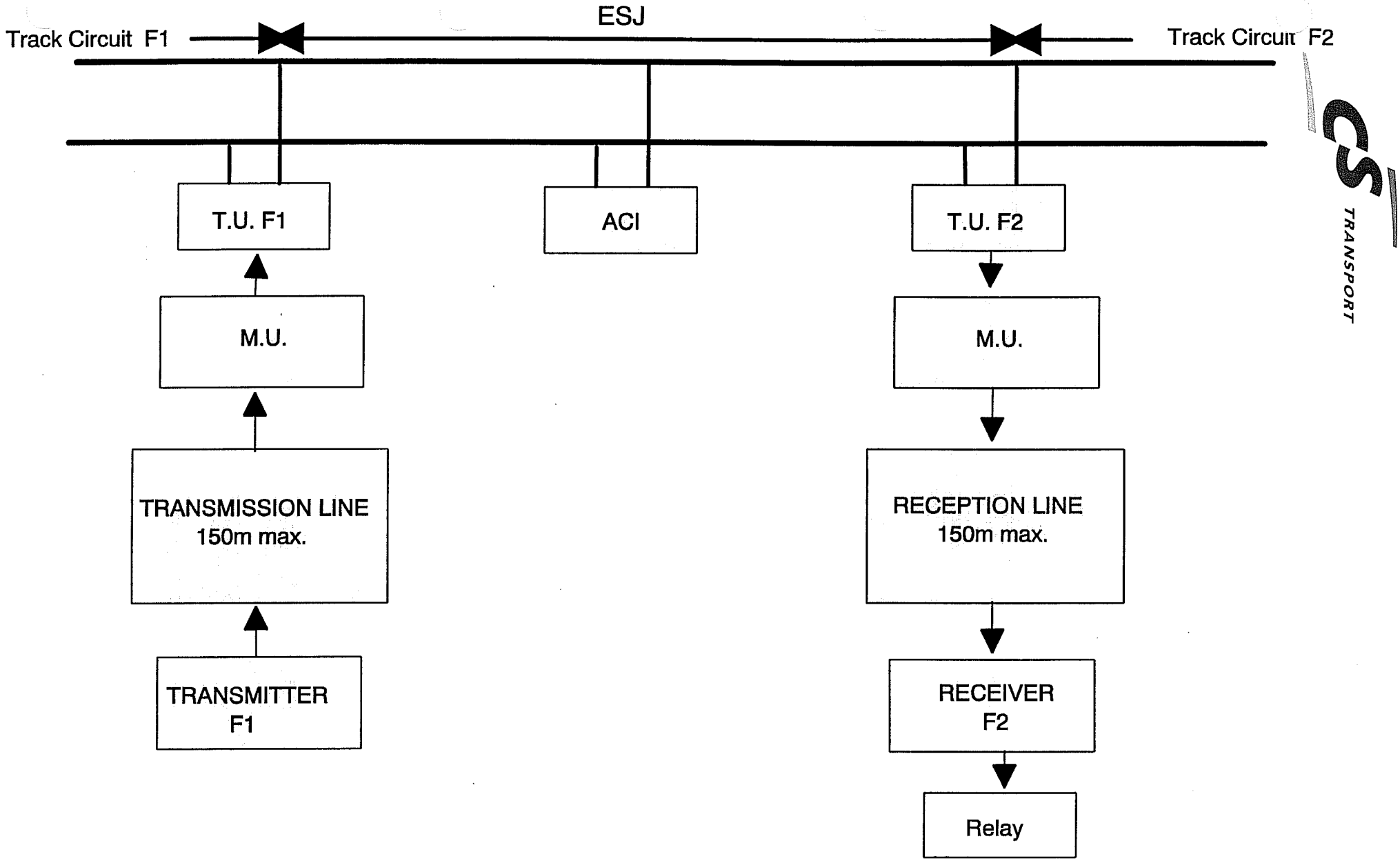

ELECTRICAL SEPARATION JOINT - ESJ
Configuration

A003

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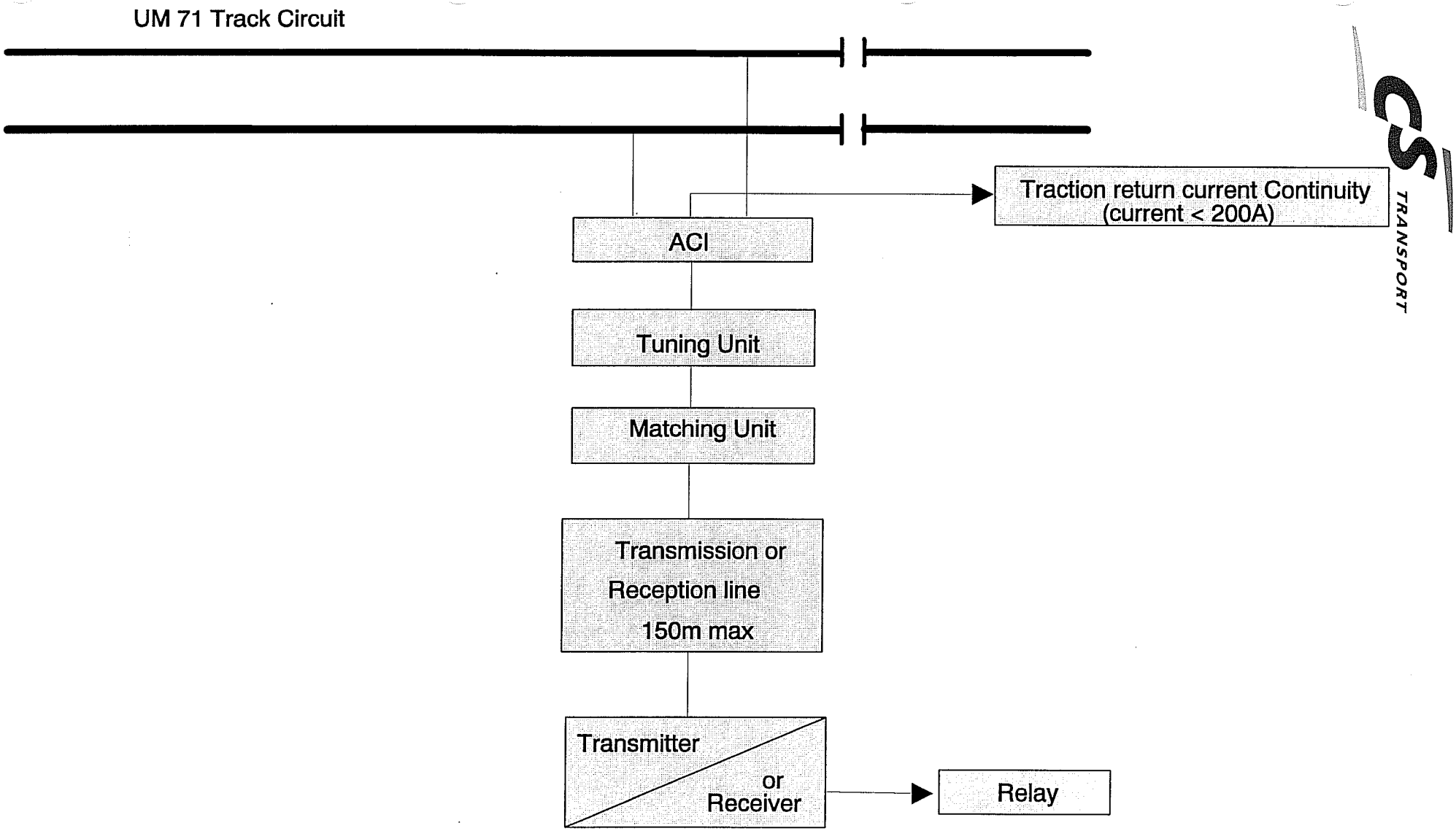
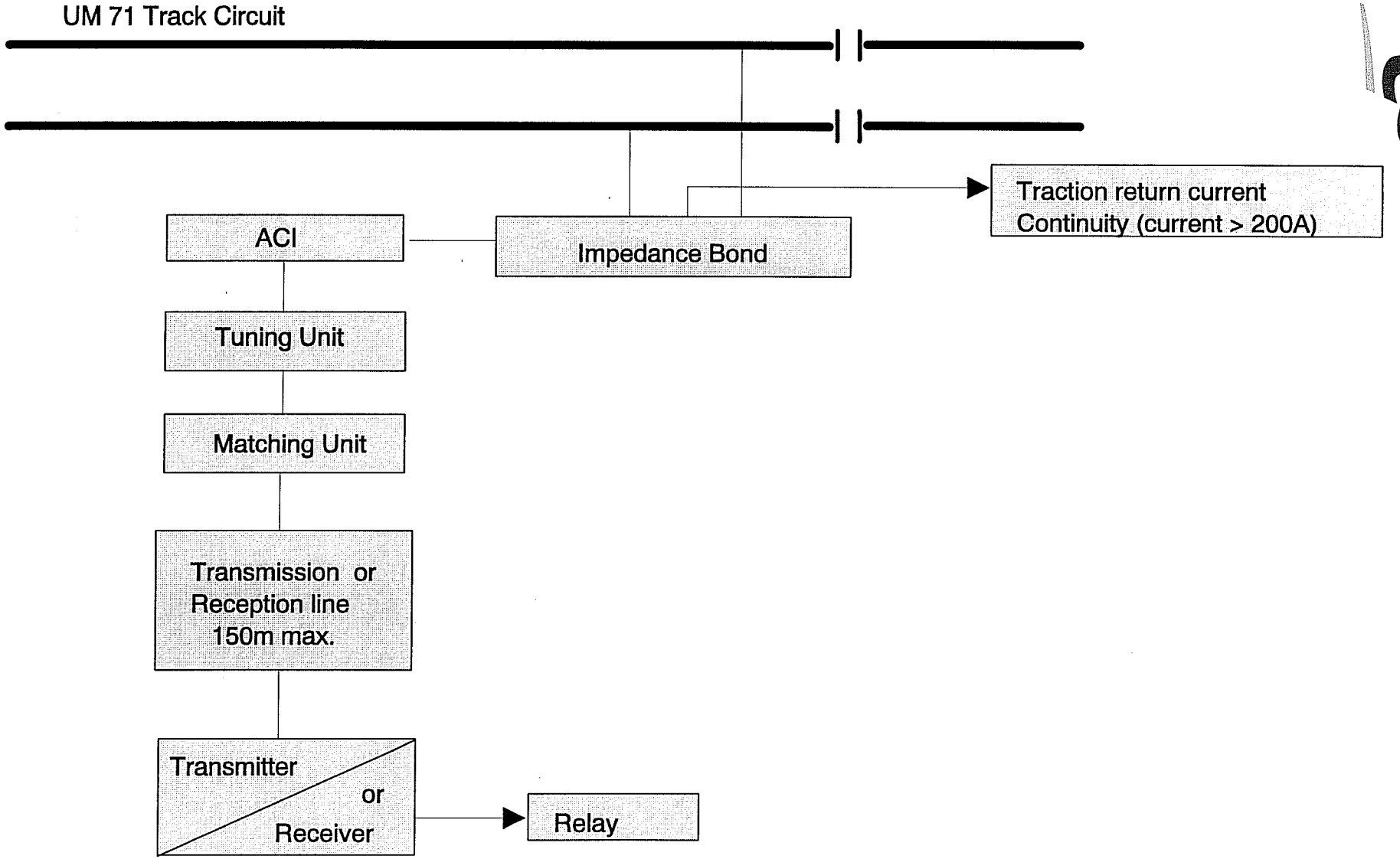


INSULATED RAIL JOINTS - IRJ
Configuration Traction current <200 Amps

A004



INSULATED RAIL JOINTS - IRJ
CONFIGURATION Traction current > 200Amps

A004B

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APPENDIX 3

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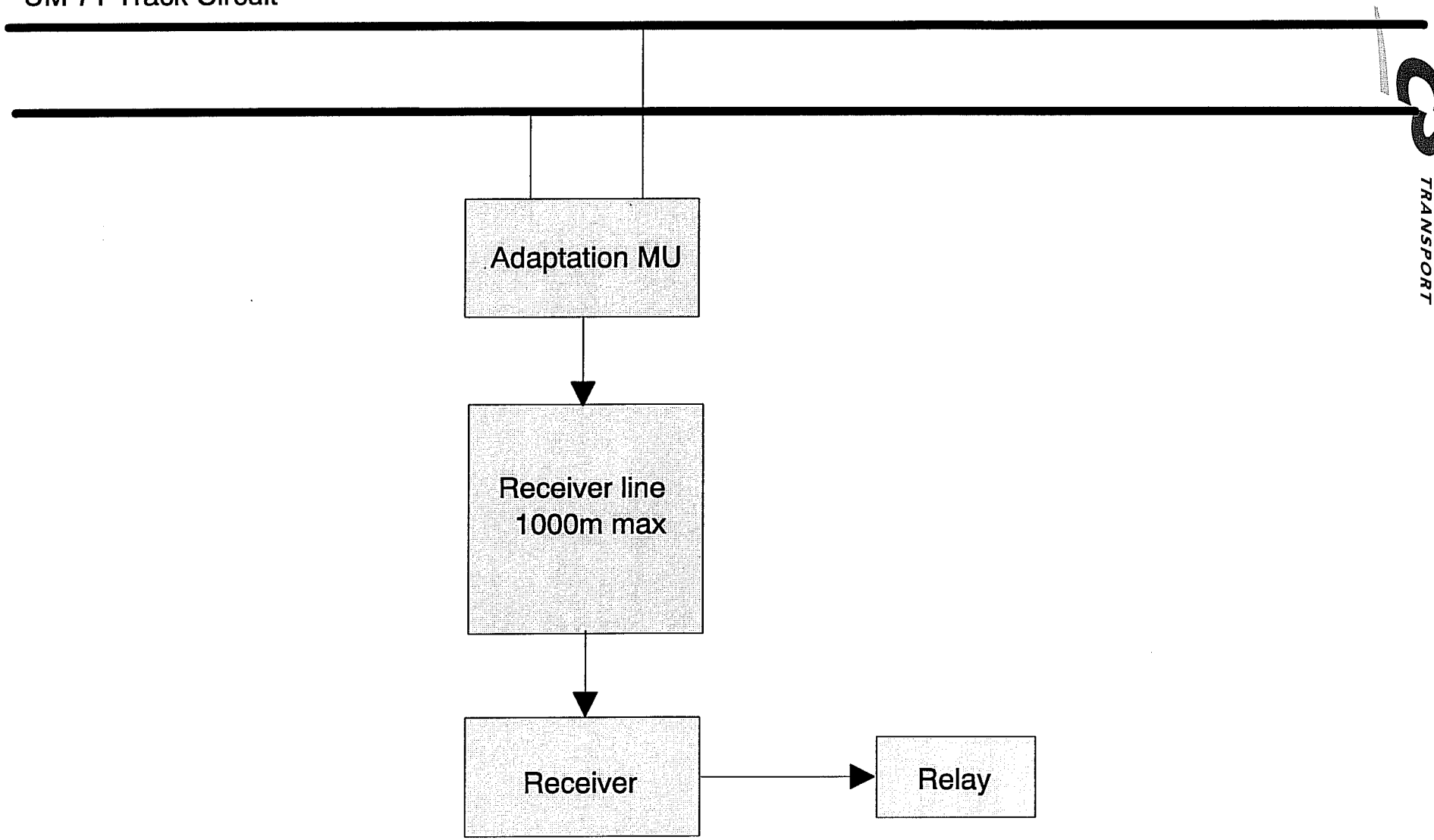
UM 71 Track Circuit



INTERMEDIATE DATA COLLECTOR - IDC
Information Point - IP
Configuration

A005

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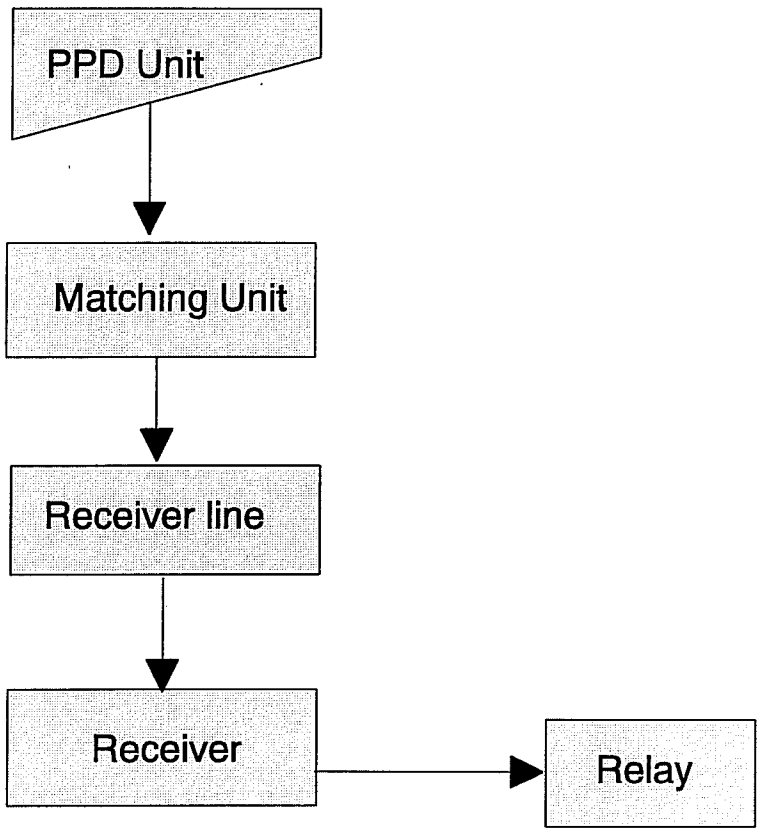

INTERMEDIATE DATA COLLECTOR - IDC
PIN POINT DETECTOR - PPD
Configuration with MU

A006a

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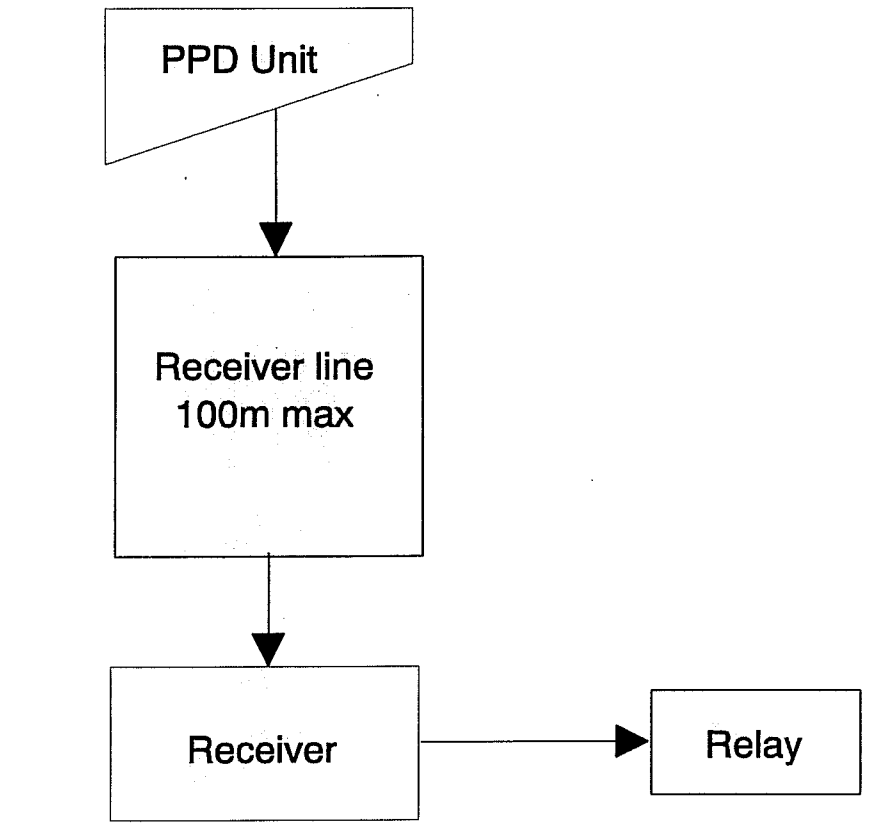

INTERMEDIATE DATA COLLECTOR - IDC
PIN POINT DETECTOR - PPD
Configuration without MU

A006b

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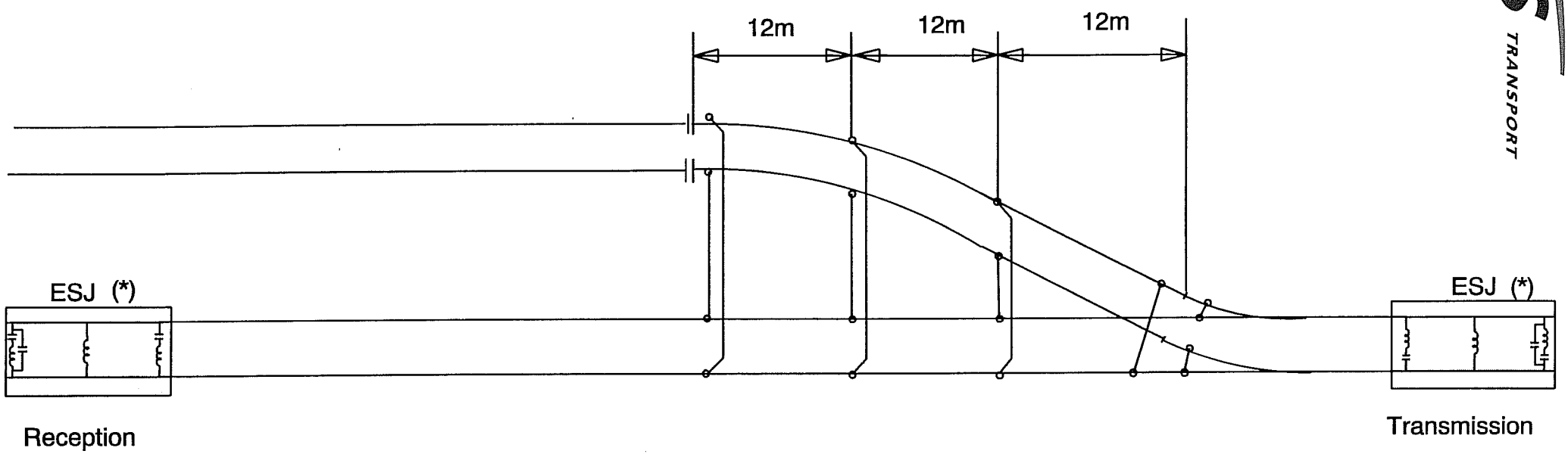
2) NORMAL TURN-OUT (length < 36m)



(*) ESJ or Insulated Rail Joints (IRJ)

TRACK CIRCUIT WITH TURN-OUT < 36m

A007

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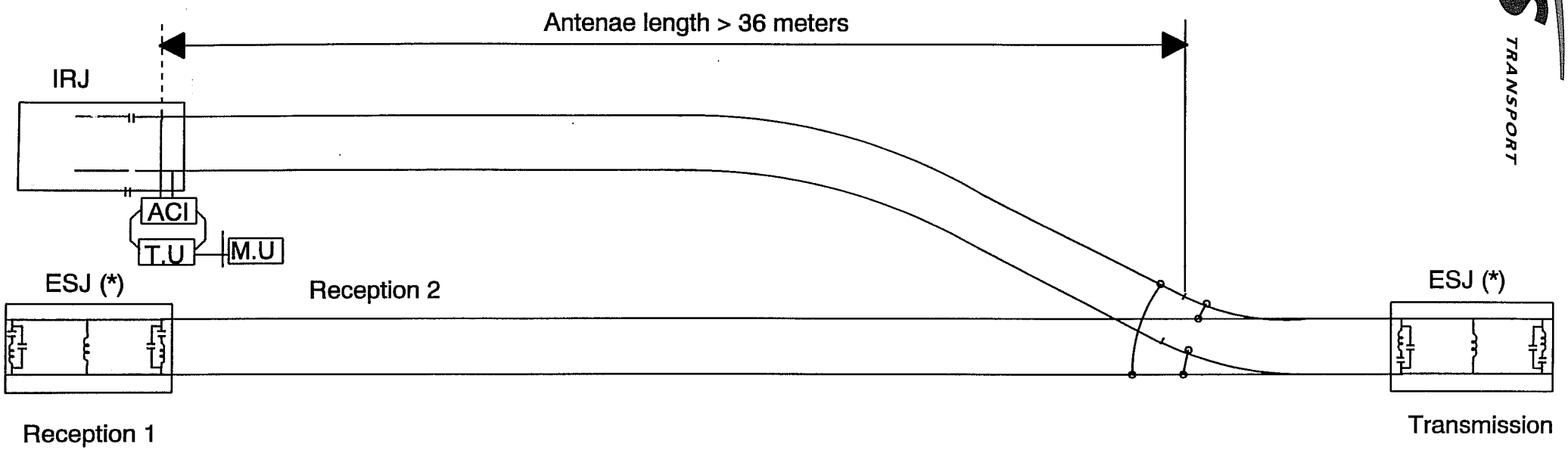
1) LONG TURN-OUT (Length > 36m)



(*) ESJ or Insulated Rail Joints(IRJ)

TRACK CIRCUIT WITH TURN-OUT > 36m

A008

APPENDIX 5

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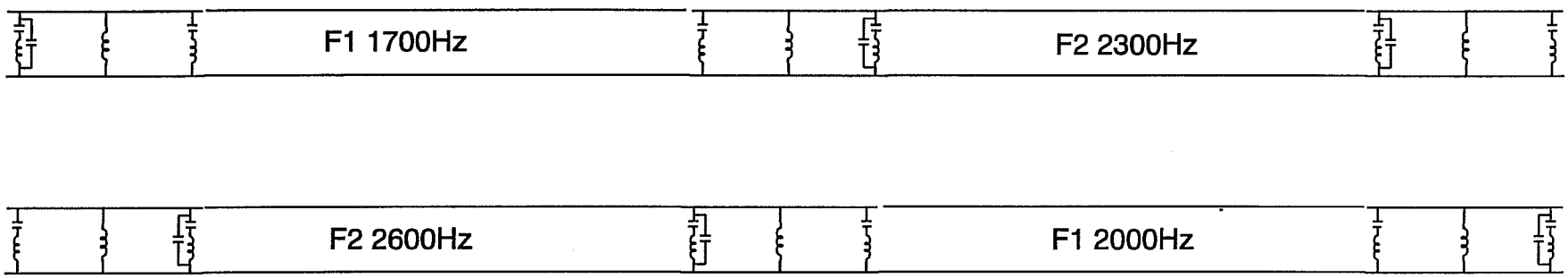
CS TRANSPORT



FREQUENCY APPLICATION

A009

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TRACK 1

ESJ	F1 1700Hz	ESJ	F2 2300Hz	ESJ

TRACK 2

ESJ	F2 2600Hz	ESJ	F1 2000Hz	ESJ

TRACK 3

ESJ	F2 2300Hz	ESJ	F1 1700Hz	ESJ

MULTIPLE PARALLEL TRACKS

FREQUENCY APPLICATION

A010

APPENDIX 6

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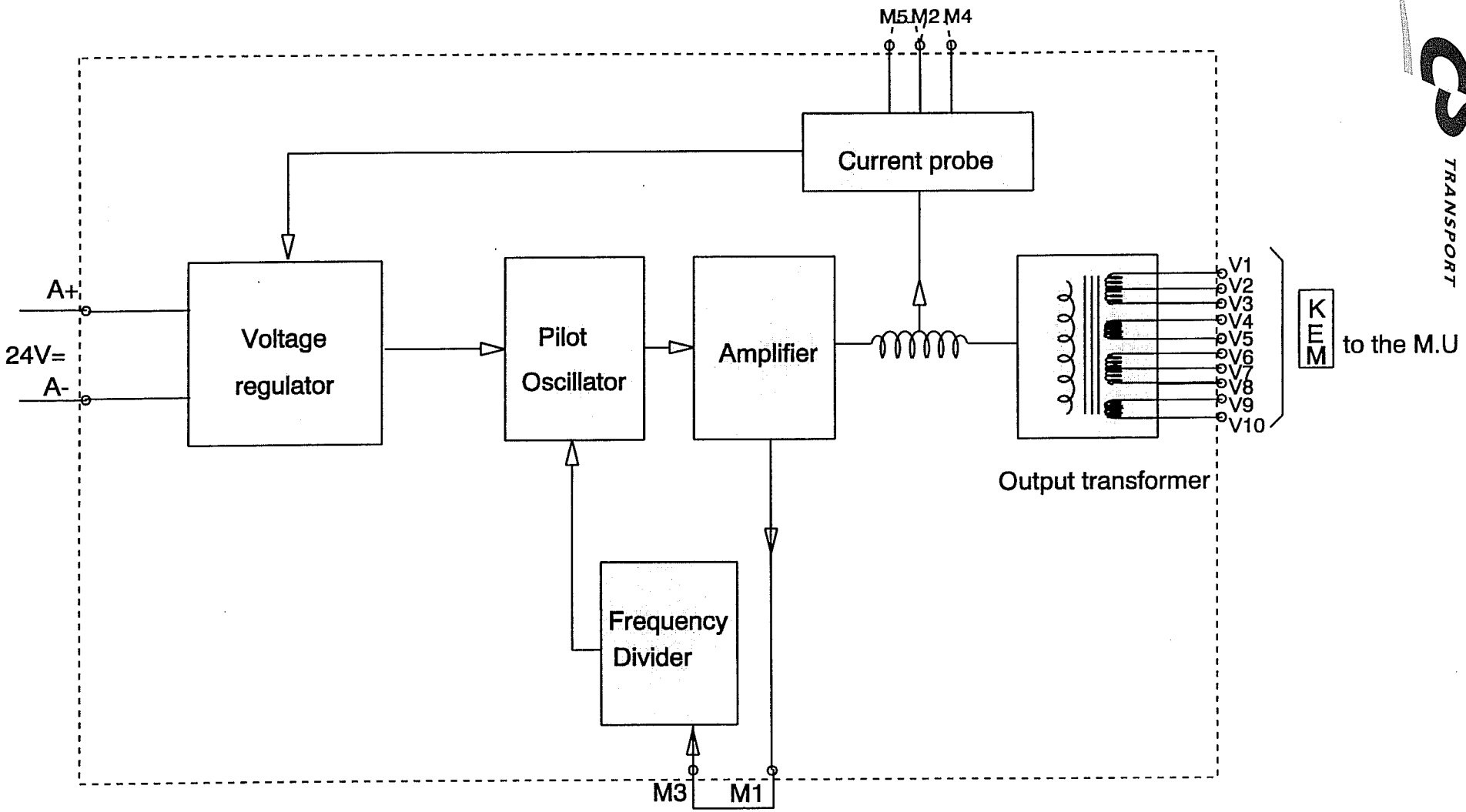

UM71 TRANSMITTER BLOCK DIAGRAM

A011

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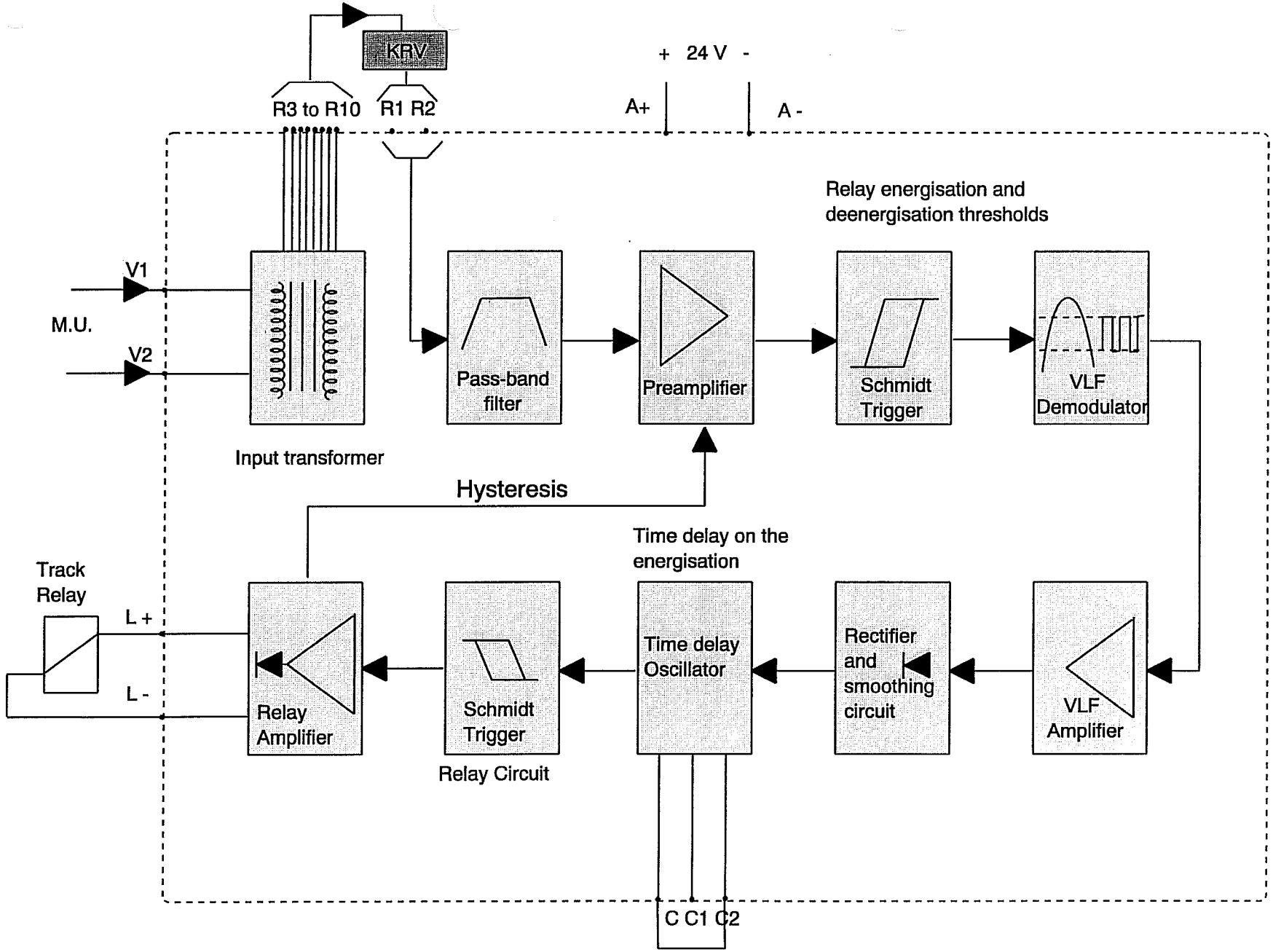

UM 71 RECEIVER BLOCK DIAGRAM

A012

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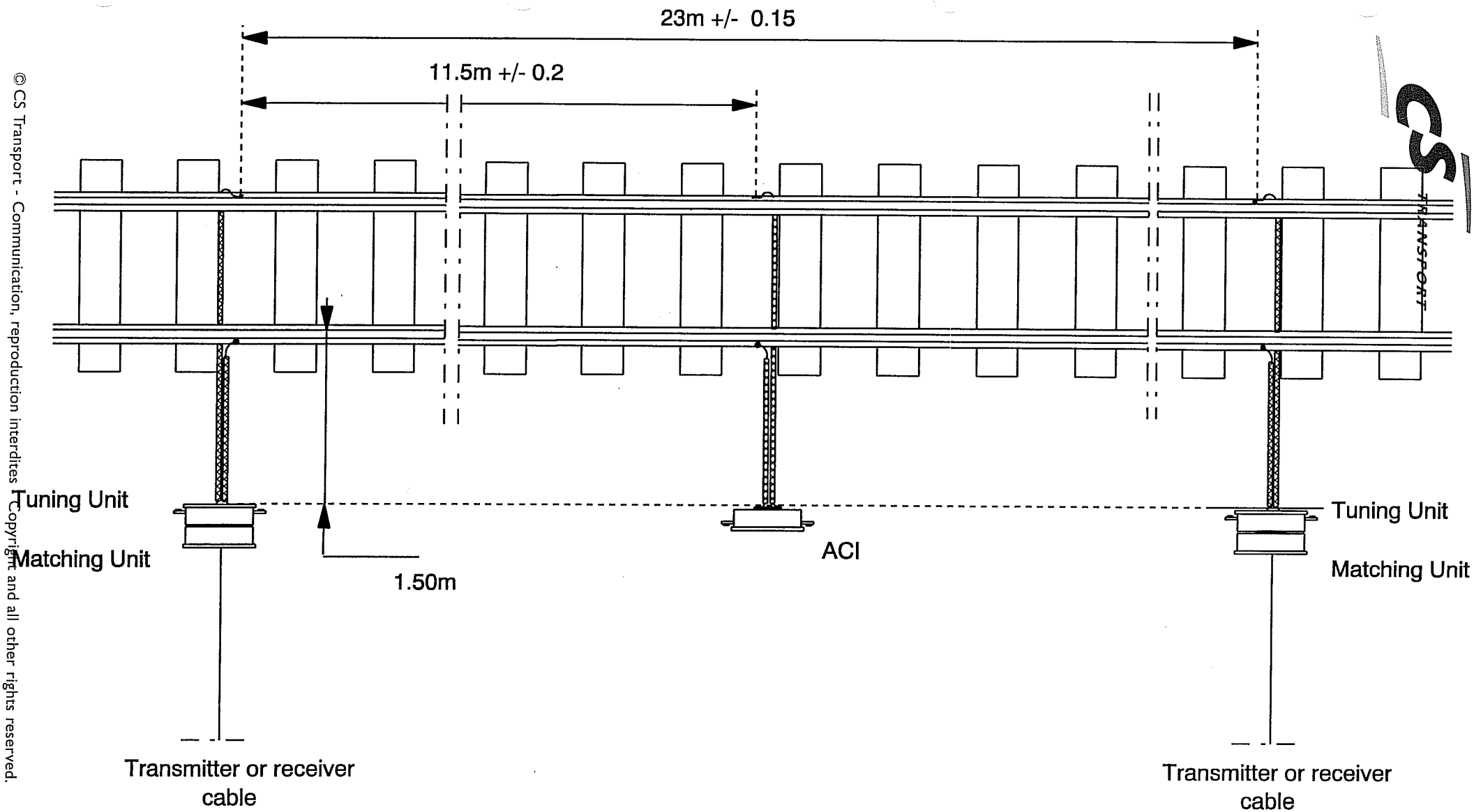

ELECTRICAL SEPARATION JOINT - ESJ

Configuration (Single M.U.)

A013A

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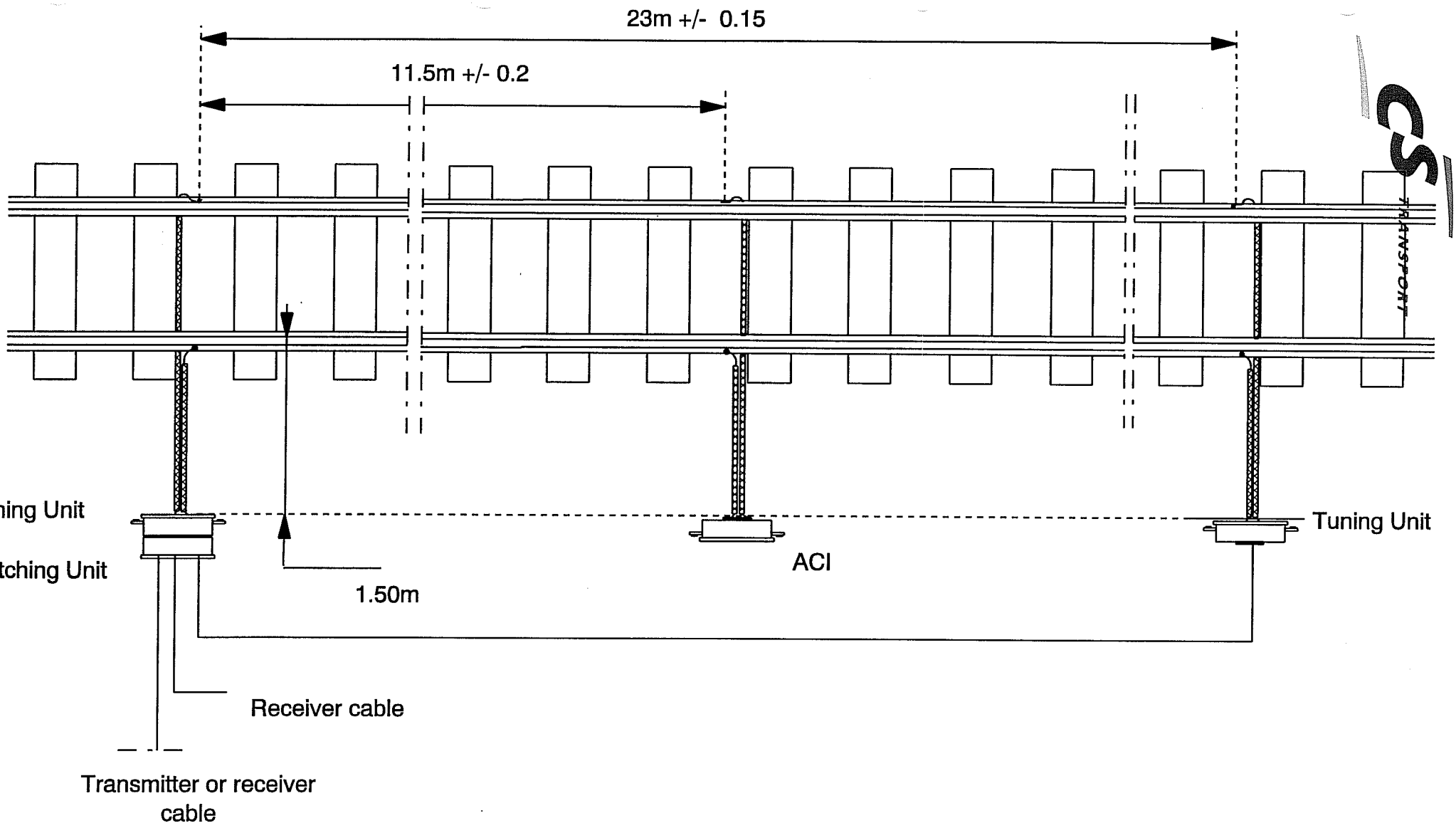

ELECTRICAL SEPARATION JOINT - ESJ

Configuration (Double M.U.)

A013B

APPENDIX 9

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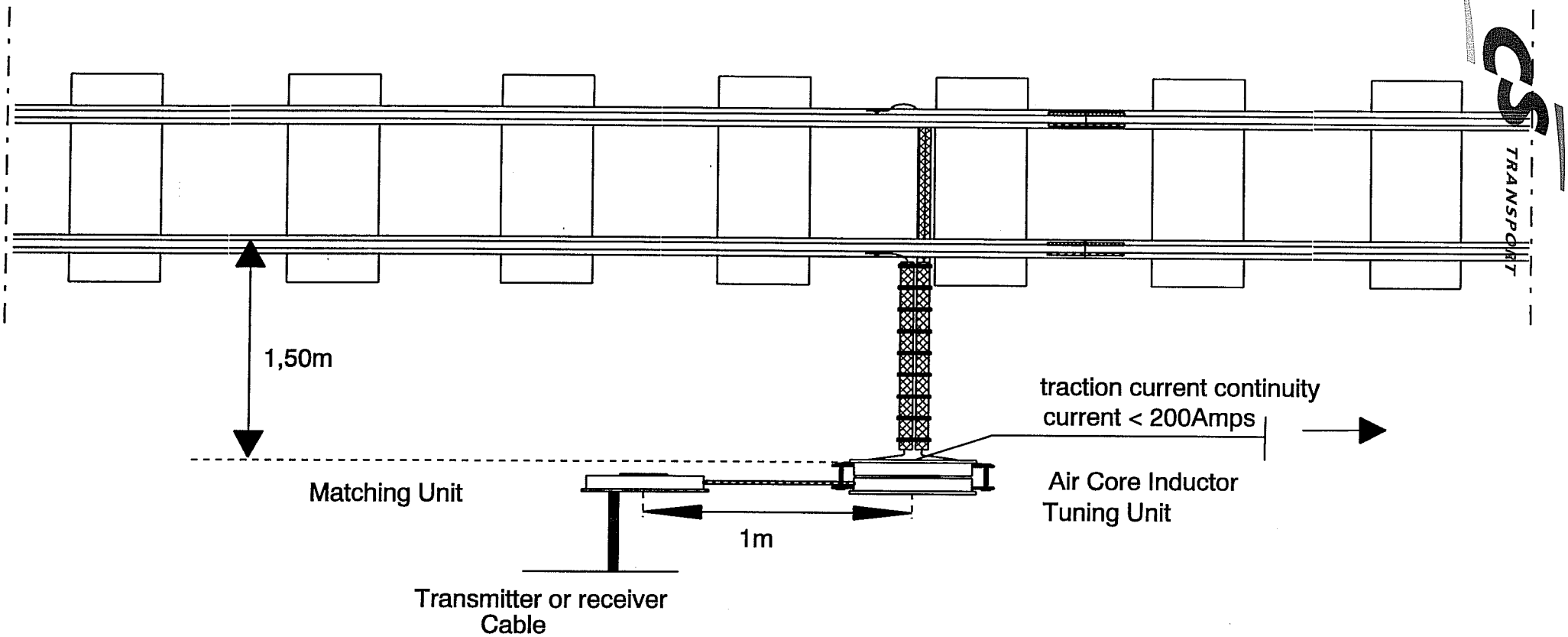

INSULATED RAIL JOINTS - IRJ

current traction < 200 Amps

A014

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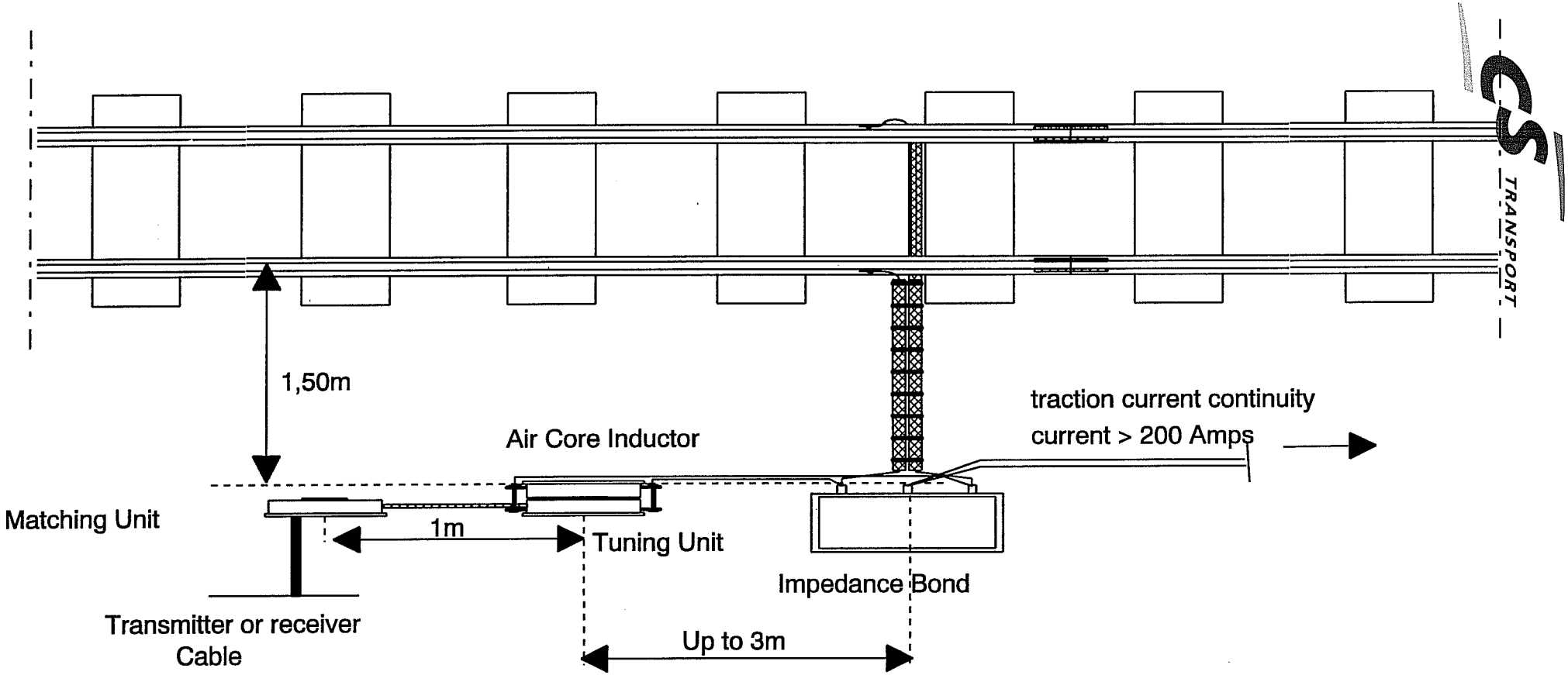

INSULATED RAIL JOINTS - IRJ
Current traction > 200 Amps

A015

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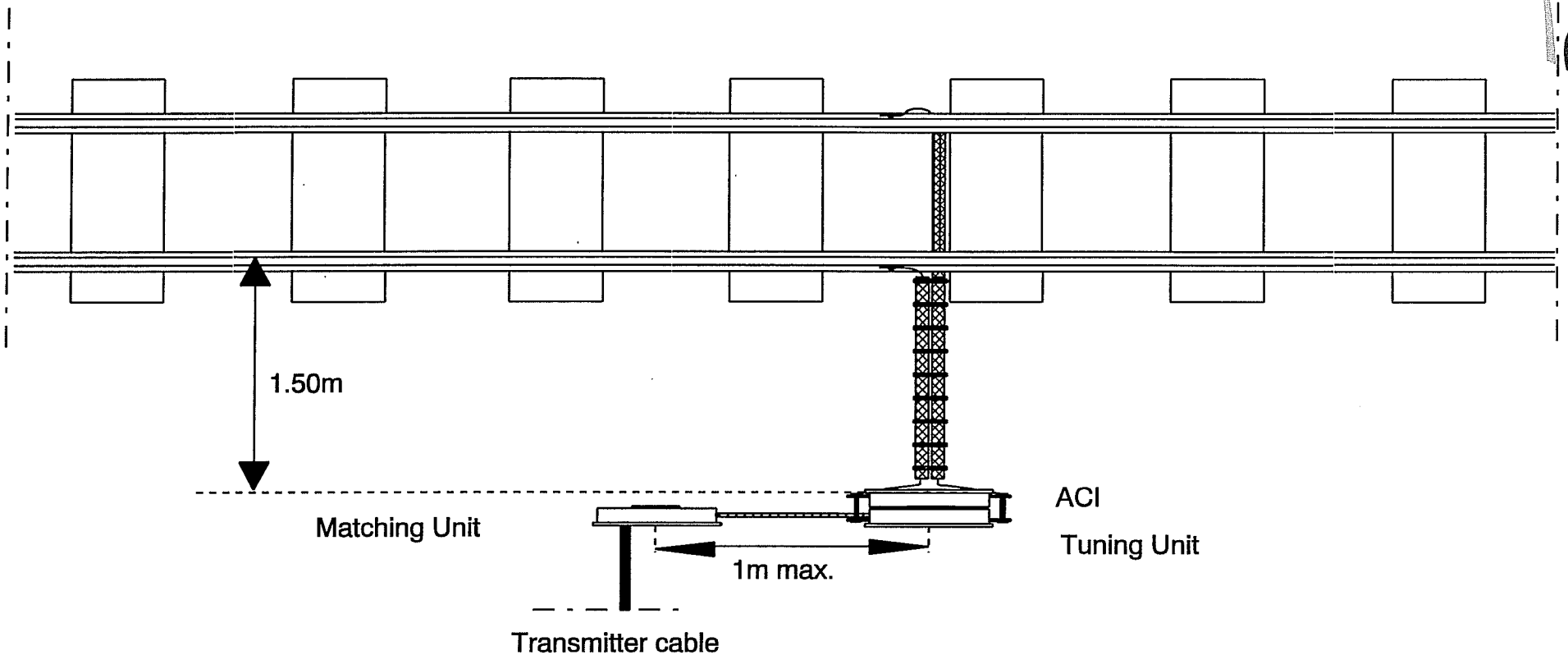

INTERMEDIATE TRANSMISSION - IT

Configuration

A016

APPENDIX 11

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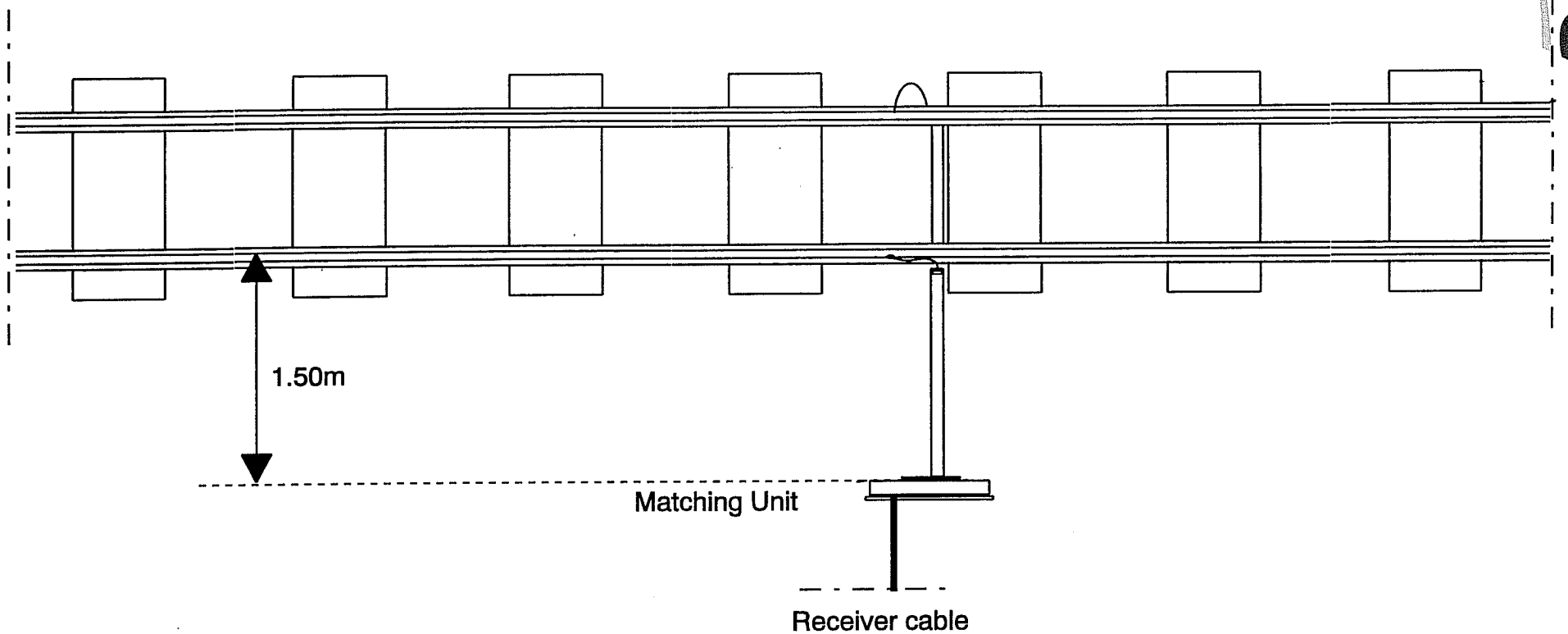

INTERMEDIATE DATA COLLECTOR -IDC

Information Point - IP - Configuration

A017

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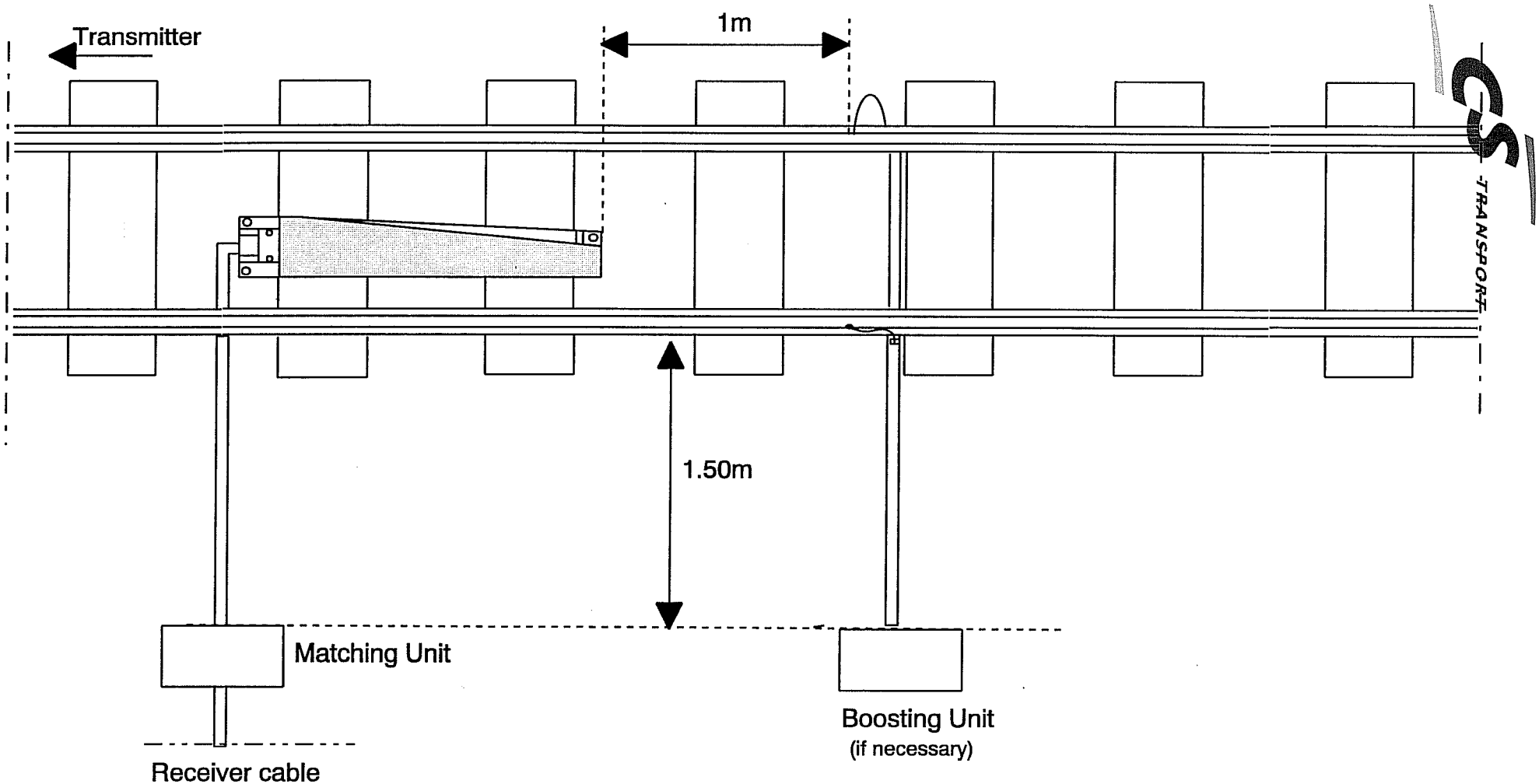

INTERMEDIATE DATA COLLECTOR -IDC

Pin Point Detector - PPD

A018

APPENDIX 12

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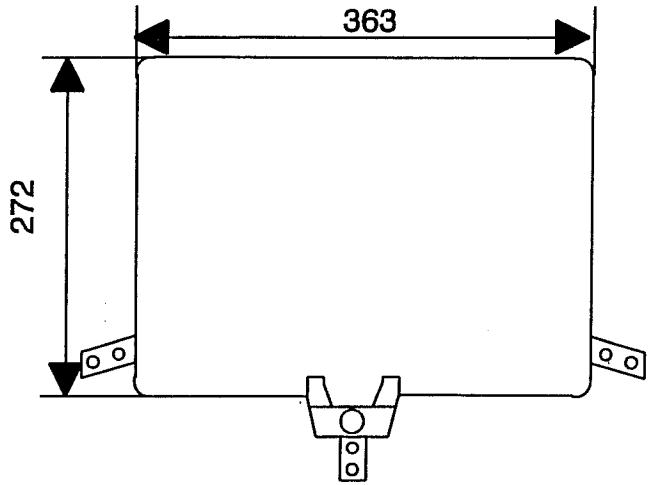

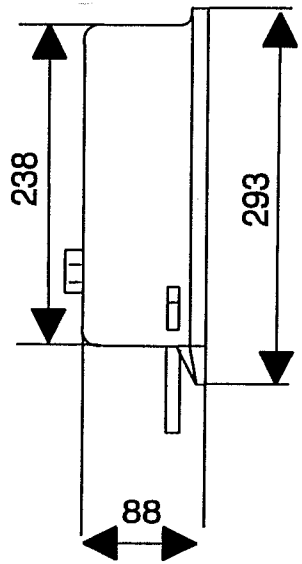

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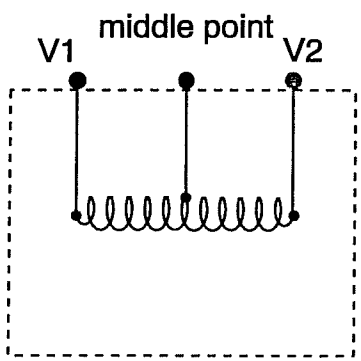

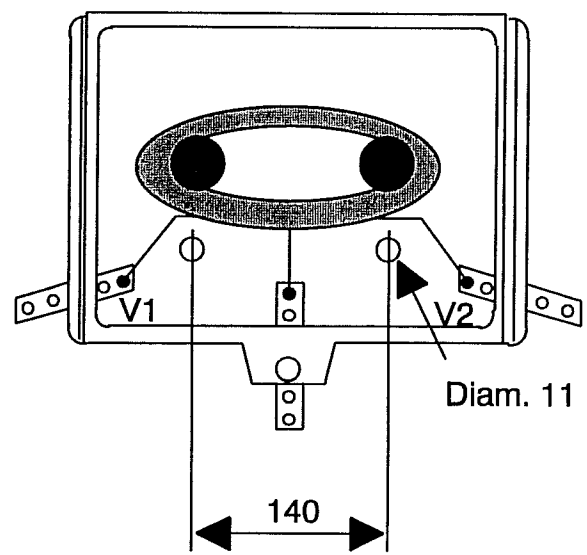

AIR CORE INDUCTOR - ACI
PRESENTATION AND MEASUREMENTS

A019

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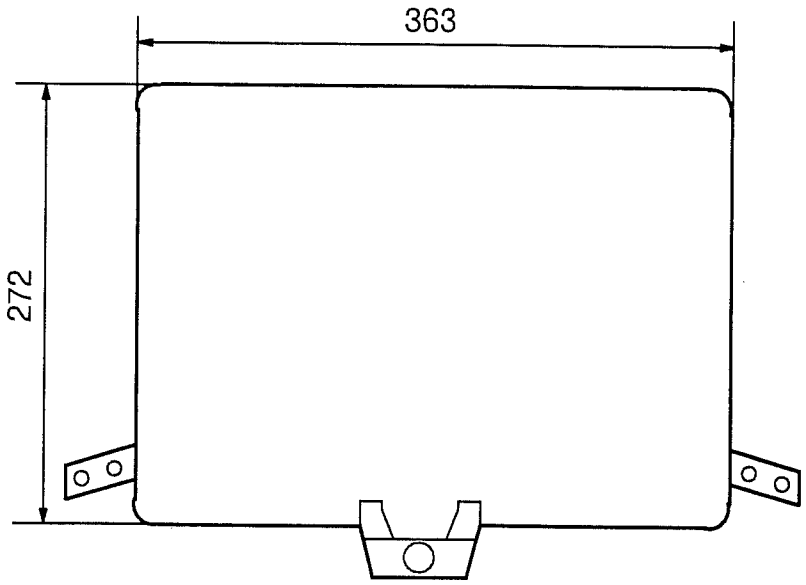
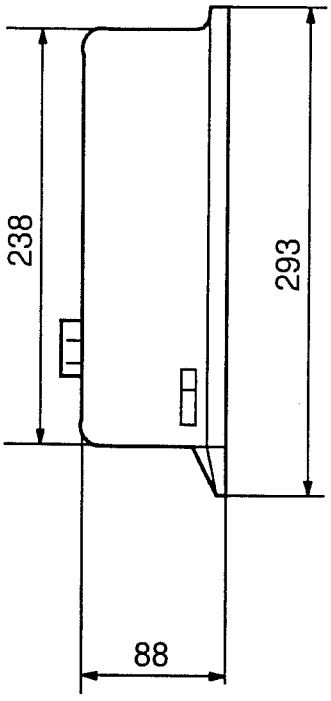
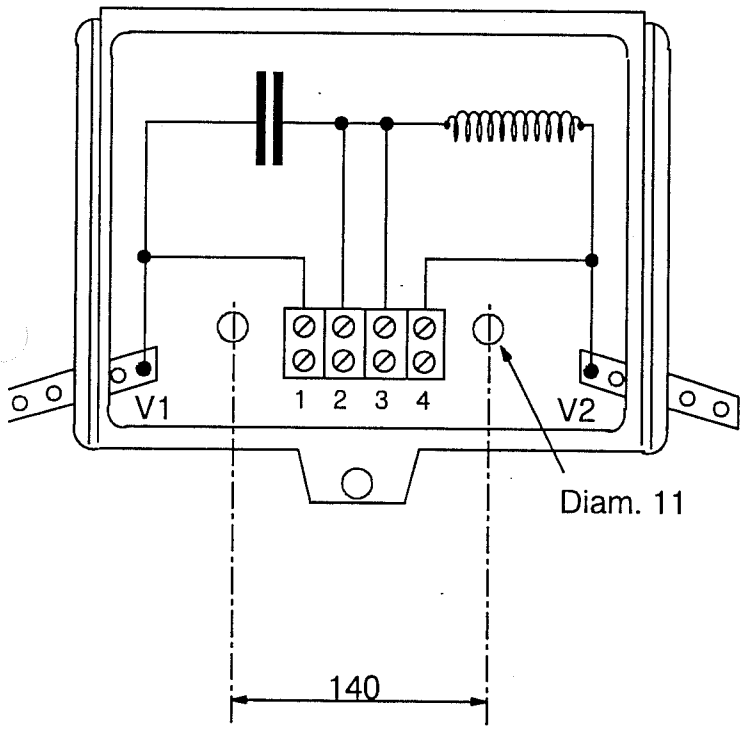




TU F1



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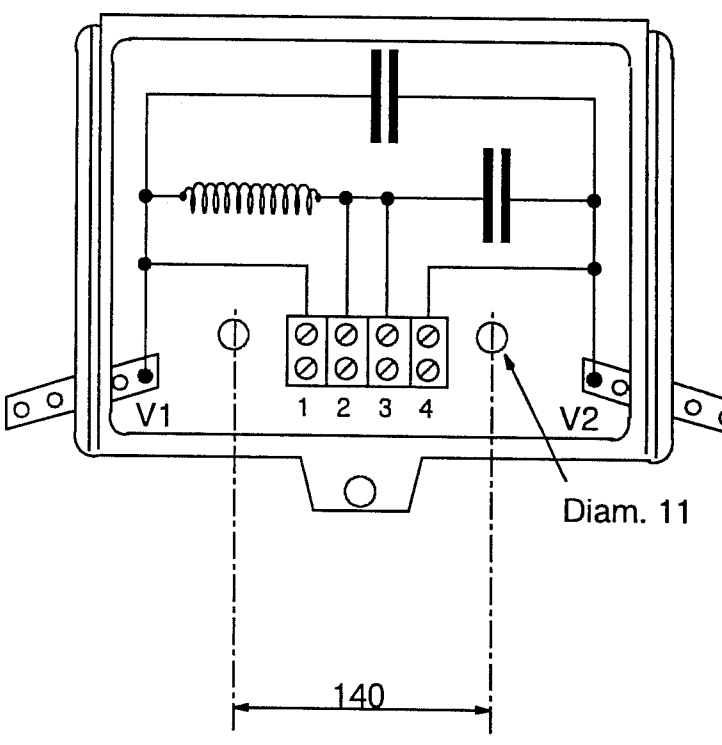

TUNING UNIT (TU)

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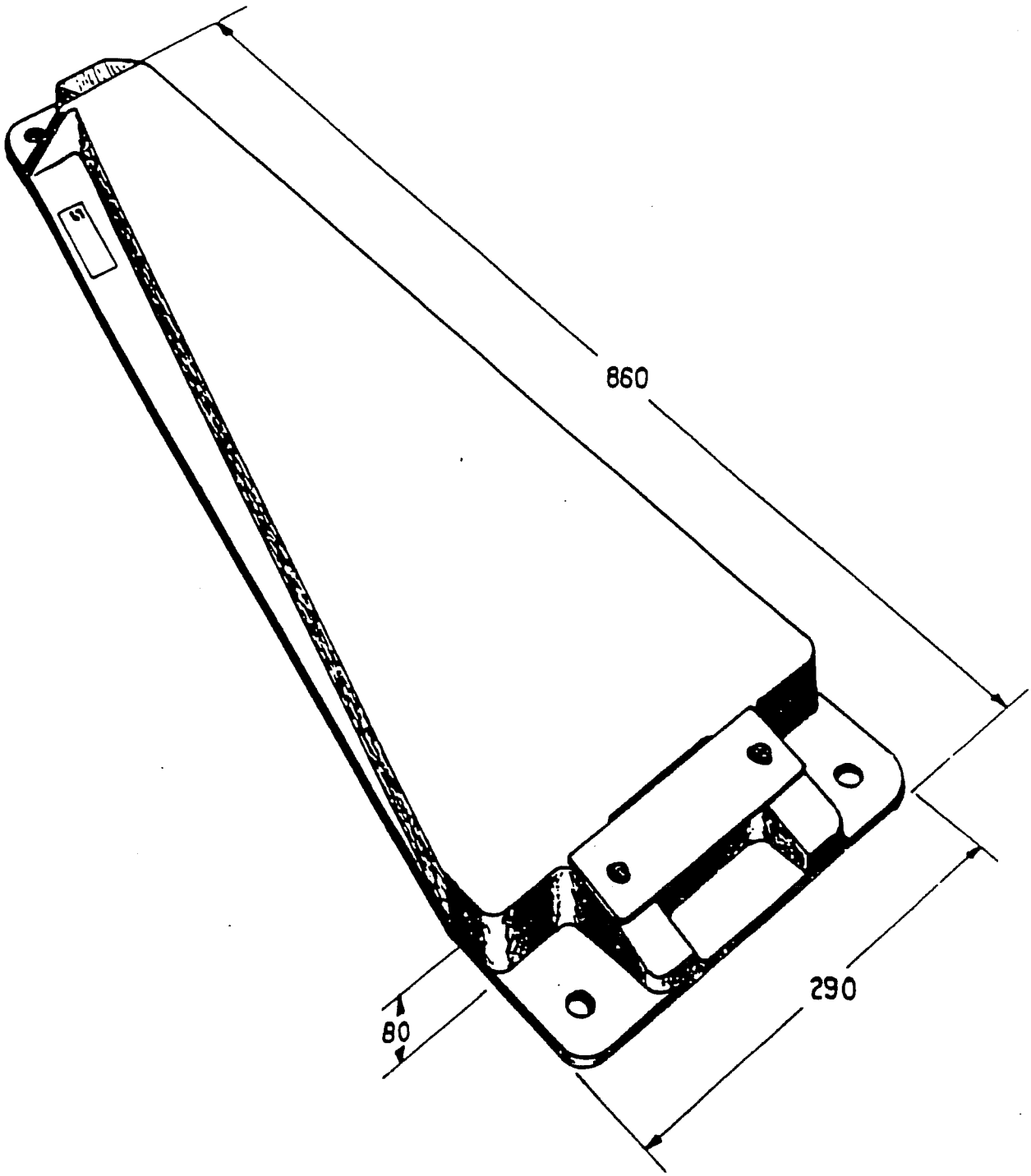

PIN POINT DETECTOR UNIT (PPDU)

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